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MILK and FOOD TECHNOLOGY

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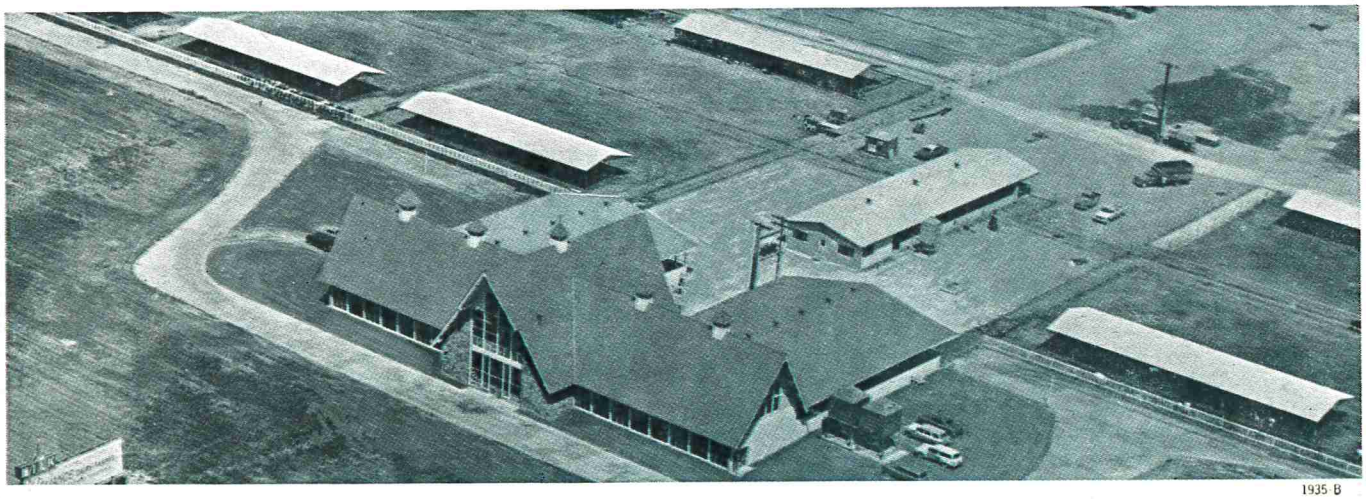

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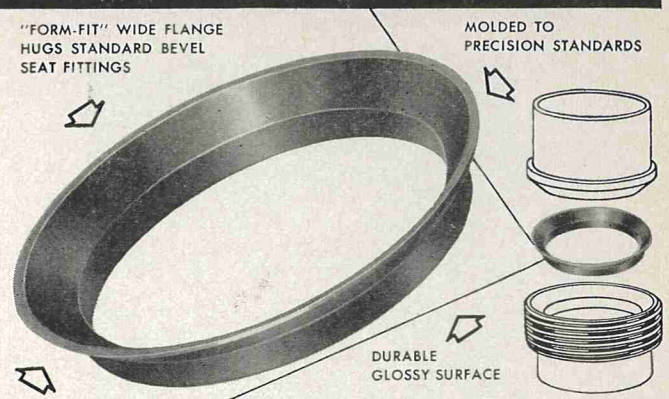

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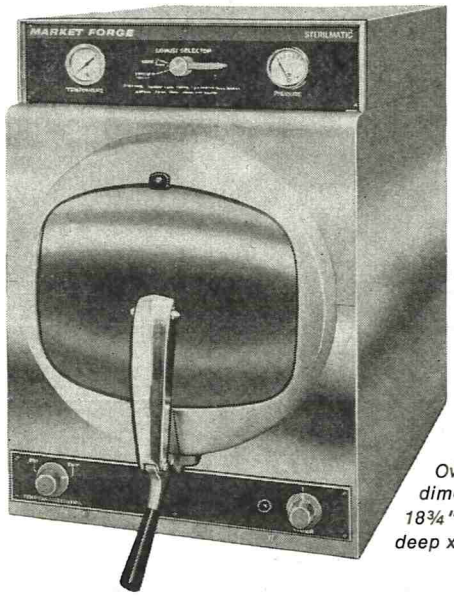

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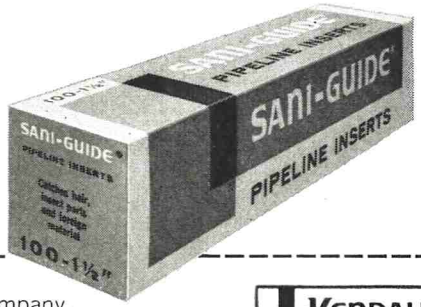

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A SANITARY SURVEY OF ICE
II. DENVER ON-THE-PREMISE ICE DISPENSERS[1]

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(Received for publication March 7, 1968)

Abstract

A survey of 551 cubed and chipped ice samples from a variety of Denver establishments using on-the-premise, automatic ice making machines was made for coliform, psychrophilic and mesophilic bacteria and sediments. Samples taken directly from the ice maker and from service bins, collected both by the operators and by field sanitarians, were examined. None of the bacterial indicators showed excessive numbers of organisms if ice is considered food rather than water. Coliform counts were low adding further evidence that they lack resistance to freezing. Most samples showed low sediment content, but a few yielded a variety of foreign substances. Like any other food product, ice should be under constant surveillance as it can be a potential public health hazard.

In recent years the increasing consumer demand for ice, particularly in cubed or crushed form, and the development of efficient economical equipment has brought about an increase in the use of on-the-premise, automatic ice making machines. Most hospitals, nursing homes, hotels, motels, bars, restaurants and large grocery stores have installed such machines rather than purchase commercially produced ice. The ice produced in these establishments is used for cooling beverages and food products and in some instances sold for household use. The results of a survey of household ice obtained from beverage stores, gasoline stations, and similar outlets has been presented in a previous paper *(6)*. In the past, the sanitary quality of ice production had to be maintained at the large ice plant where most users obtained their supply. The present situation requires that sanitary control of ice quality be enforced on an individual business level.

Ice produced from high quality water and handled in a sanitary manner as a food commodity will be superior to the input water, bacteriologically, because of the reduction in viable bacterial numbers during the freezing process and storage *(8,* Morrison and McCarron unpublished data). However, it has been shown that using low quality water, poorly designed equipment and, especially, insanitary storage and handling procedures will yield highly contaminated ice *(4, 9)*. Ice, then, may be considered a potential food-borne health hazard.

This study was initiated to determine the relative level of bacterial contamination that exists in the ice being used in a large number of City of Denver establishments that have on-the-premise ice making machines.

Materials and Methods

During the period of November, 1965 until December, 1966, 551 cubed and chipped ice samples were collected and tested in the laboratory. Field collections were made by sanitarians from the food section of the Environmental Health Service of the Department of Health and Hospitals of the City and County of Denver at ice machines and storage facilities of hospitals, nursing homes, hotels and motels, bars and restaurants, and grocery stores. The laboratory tests were conducted in the Environmental Health Laboratory.

At each collection site the type and model of machine and other pertinent data were recorded on the survey forms (Fig. 1). Two samples were collected: one in a quart waxed container for sediment determination and the other in a pint-size resealable plastic bag (Whirl-Pak) for bacteriological examination. Ice machine samples were of freshly ejected ice to represent the sanitary condition of the machine, while storage bin samples were collected at random. Transportation to the laboratory (3-4 hr) was in insulated chests to minimize melting of the samples.

Coliform index alone, commonly used for water, was not considered an adequate accurate index for ice sanitary quality. Coliforms are very sensitive to freezing and freezing storage *(3, 7, 8)*. Therefore, bacteriological testing of each sample included determination of coliforms, total count at 35 C for 48 hr and psychrophiles, 14 days at 5 C. One or two plastic bag samples were melted at a time in a 48 to 55 C water bath and 100 ml of each sample passed through a mem-

[1]This study was supported by research project EF 00507 of the U. S. Public Health Service.

brane filter (Millipore HA, 0.45 μ) for coliform testing. The membranes were cultured on m-Endo medium (Difco) according to procedure of *Standard Methods for the Examination of Water and Wastewater (2)*. For total mesophilic and psychrophilic counts, duplicate 25 ml ice melt samples were filtered through membranes (Millipore HA) and placed on absorbent pads saturated with m-plate count broth (Difco) and incubated. Membranes received malachite green wash before reading to make colonies more visible *(1)* and were read with the aid of a binocular dissecting microscope *(2)*. All counts were reported as number of bacteria per 100 ml of ice melt.

For an approximation of the quantity and type of suspended solids present in the ice samples, 500 ml of ice melt were passed through a cotton milk filter pad and the sediments compared visually with the milk sediment standards of the U.S.D.A. *(1)*.

RESULTS AND DISCUSSION

The mesophilic bacterial counts, psychrophilic counts and coliforms in 551 samples obtained from a variety of ice machine locations are presented in Table 1. Within each category of business establishment, mean counts and per cent frequency distribution of the three bacterial observations are presented for both the ice making units and the service bins where they were being used. The bacterial counts are grouped into arbitrary ranges of counts per 100 ml.

The ice-making units in every establishment but one, a hospital that had a potable well water supply, were connected to the Denver municipal water system which is under constant surveillance for viable coliforms. If ice is considered a form of water, then the mean coliform counts in the ice freshly ejected from the machines exceeded allowable levels in some instances. However, 91% of the coliform counts from machine ice fell in the <1 per 100 ml range. From the service bin where the ice has been stored and has had human handling contact, the ice samples yielded somewhat greater numbers of coliforms, with 70% of the samples having <1 per 100 ml. In the hotel

TABLE 1. MICROBIAL FREQUENCY DISTRIBUTION SURVEY OF DENVER ICE DISPENSING UNITS

Type of business	Sample source	No. of samples	Total viable counts /100 ml at 35 C: % Frequency distribution 1-9	10-99	100-999	1000-9999	10000+	Mean	Total viable counts /100 ml at 5 C: % Frequency distribution 1-9	10-99	100-999	1000-9999	10000+	Mean	Coliforms/100 ml: % Frequency distribution <1	1-9	10-99	100+	Mean
Hospitals	M	70	17	51	24	7	0	350	10	40	34	14	1	750	97	1	1	0	<1
	S	15	13	47	20	20	0	560	13	47	13	27	0	670	100	0	0	0	<1
Nursing Homes[a]	M	14	14	50	21	7	7	1300	0	43	36	21	0	480	71	21	7	0	4
Hotels and Motels	M	52	6	50	27	17	0	610	0	35	35	31	0	1200	96	0	2	2	4
	S	12	0	42	42	17	0	410	0	8	67	25	0	780	67	33	0	0	1
Grocery Stores[a]	M	54	4	43	35	19	0	590	2	38	31	29	0	1300	83	6	6	6	12
Bars	M	24	4	63	33	0	0	170	0	8	58	33	0	1100	92	8	8	0	1
	S	48	2	29	42	27	0	960	0	4	38	51	6	2600	65	19	13	4	13
Restaurants	M	62	2	65	34	0	0	120	7	28	42	22	2	870	95	3	0	2	3
	S	75	0	36	51	13	0	620	4	23	41	31	1	1600	80	8	4	8	19
Restaurants Bars	M	43	12	51	26	5	7	1500	0	30	47	23	0	1100	86	9	2	2	16
	S	82	2	24	35	30	7	2300	1	10	39	43	7	2900	59	16	16	10	49
Subtotals	M	319	8	53	29	8	1	570	4	33	39	24	0	1000	91	4	3	2	6
	S	232	2	31	41	23	3	1300	3	15	39	39	4	2200	70	14	9	7	26
Total	M&S	551	6	44	34	15	2	860	3	25	39	30	2	1500	82	8	5	4	14

M = Ice Machine

S = Service bin

[a] = No service bins in use

TABLE 2. SURVEY OF ICE (CHIPPED AND CUBED) FROM DISPENSING UNITS IN DENVER FOR MESOPHILIC, PSYCHROPHILIC AND COLIFORM BACTERIA PER 100 ML

Type of ice sample	35 C Incubation		5 C Incubation		Coliforms	
	No. of samples	Mean viable count	No. of samples	Mean viable count	No. of samples	Mean viable count
Machine	319	570	311	1000	319	6
Service bin	127	1200	124	2400	127	32
SB-Operator	105	1400	104	1900	105	19
Total Chipped Ice	148	540	144	1100	148	13
Total Ice Cubes	403	980	395	1700	403	15
Total Ice Samples	551	860	539	1500	551	14

Machine = ice sample taken from the storage bin of the ice machine.

Service bin = storage bin not connected with the ice machine. Located at service counter. Sample taken by sanitarian.

SB-Operator = ice sample taken from service bin by employees of establishment.

and motel group the apparent larger mean coliform counts for the ice from the machines result from a few very high counts and emphasizes the greater reliability of using per cent frequency distribution for evaluating results.

Were ice considered a food item, the coliform counts throughout the survey must be considered very low and indicate that coliforms may be an inadequate single index for determining ice quality.

The service bins, where they were in use, yielded somewhat higher mesophilic count ice than the machines, with the exception of the hotels and motels. Some addition to the mesophilic total count of the ice seems to occur as a result of human contact.

The same general relationship between ice machines and service bins was observed for psychrophilic organisms (bacteria and yeast cells) in the ice, although the numbers of psychrophiles were slightly higher. The cold environment of the ice making and storage equipment probably encourages the survival of this slightly larger number of psychrophiles. Although it might be tempting to recommend psychrophilic counts to supplement coliform determinations, the results of this survey do not justify the long incubation period necessary.

Although none of the bacterial indicators showed many ice samples with excessive numbers of organisms, it must be emphasized that all the machines are fed by good quality chlorinated water and that all the establishments are under continuing sanitary surveillance.

Table 2 presents an analysis of the data to determine differences caused by the sampling procedure and type of ice produced. When ice samples were collected from the service bins by the establishment operator, the mean bacterial yields in each of the three tests were the same as when the sanitarian collected the samples. These results were contrary to our predictions. Also, contrary to the reported works of Foltz *(4)* and Moore *(9)*, no significant difference in sanitary level was observed between cubed and crushed ice. Our results slightly favor chipped ice with one exception. The bacterial counts of ice from grocery stores where separate crushers were used were higher than those from stores with machines producing chipped ice.

The results of sediment determinations in ice are presented in Table 3. The evaluation by milk sediment chart provided a convenient method of approximating ice sediments, even though the solids were probably of different types and sources.

While most samples tested showed no more than a faint trace of foreign matter (0 and 1), a few samples did show increased amounts of sediment. The observed sediment distribution was somewhat higher in the service bins than in the machines. While the sediments were almost the same in cubes or chipped ice at the machine, the chipped ice in the service bins gave many more high foreign matter samples. This probably results from the larger exposed surface of this finely chipped ice, providing greater opportunity for a human and environmental contamination. Sediment tests on Denver water supply were usually 0 and never gave more than a reading of 1.

Observations for which quantitative evaluations are not given were: *(a)* no correlation was observed between high sediment levels and high bacterial content; *(b)* microscopic examination of the sediment disks showed an assortment of identifiable substances as hair, lime deposits, salt crystals, oil, sand, rust,

DEPARTMENT OF HEALTH AND HOSPITALS 11
City and County of Denver
Environmental Health Service
LABORATORY ANALYSIS REPORT

OWNER_____

ADDRESS_____

TYPE OF BUSINESS_____

ICE USED FOR: 1. Beverage cooling_____
2. Food contact_____
3. Resale_____
4. Inedible purposes_____

TYPE OF ICE: 1. Cube_____
2. Chip_____
3. Other_____

ICE MACHINE

Location	Machine Name and Model	Sample Obtained Yes	No

WATER SUPPLY TO ICE MACHINE:
Municipal_____ Private_____
Cross Connections: Yes___ No___

CONSTRUCTION OF ICE MACHINE:
Dispensing outlet protected: Yes___ No___

CLEANING OF ICE MACHINE:
Food contact surfaces clean: Yes___ No___
Machine interior clean: Yes____ No____
Approved cleaning procedures: Yes___ No___

ICE STORAGE BINS

Location	Type of Construction	Sample Obtained Yes	No

CLEANING OF ICE STORAGE BINS:
Food contact surfaces clean: Yes___ No___
Bin interior clean: Yes_____ No_____
Approved cleaning procedures: Yes___ No___

ACCESSIBILITY OF ICE MACHINES & STORAGE BINS:
Accessibility to machine by:
Food personnel only_____
Anyone_____

ICE SCOOP AVAILABLE: Yes_____ No_____

BACTERIOLOGICAL AND SEDIMENT RESULTS

BACTERIOLOGICAL RESULTS

Sample	Total Counts/100 ml. (Millipore) 35°C.	5°C.	Coli/100 ml. (Millipore)	Other	SEDIMENT RESULTS

Inspector: _____ Date: _____

Fig. 1. Ice Dispenser survey form

TABLE 3. SEDIMENTS IN ICE SAMPLES RATED 0 TO 5 ACCORDING TO THE U.S.D.A. SEDIMENT STANDARDS FOR MILK AND MILK PRODUCTS

Source		Ice type	% Distribution						No. of samples
			0	1	2	3	4	5	
Hospitals	Machine	Cubes	0	71	17	11	0	0	35
		Chipped	0	95	5	0	0	0	19
	Service Bin	Cubes	17	67	8	0	0	8	12
Nursing Homes	Machine	Cubes	0	88	0	13	0	0	8
		Chipped	0	60	20	20	0	0	5
Hotels and Motels	Machine	Cubes	2	40	37	19	2	0	43
		Chipped	0	50	0	0	0	50	2
	Service Bin	Cubes	0	43	14	0	14	29	7
Grocery Stores	Machine	Cubes	0	73	9	5	5	9	22
		Chipped	0	43	29	14	7	7	14
Bars	Machine	Cubes	0	79	17	0	4	0	24
		Chipped	0	100	0	0	0	0	1
	Service Bin	Cubes	0	35	26	17	4	17	23
		Chipped	0	100	0	0	0	0	1
Restaurants	Machine	Cubes	8	75	12	0	0	4	24
		Chipped	4	37	26	19	7	7	27
	Service Bin	Cubes	0	35	25	15	15	10	20
		Chipped	0	24	18	29	24	6	17
Restaurant Bars	Machine	Cubes	11	64	17	6	0	3	36
		Chipped	0	40	0	40	0	20	5
	Service Bin	Cubes	9	35	18	21	3	15	34
		Chipped	0	0	14	43	29	14	7
Subtotals	Machine	Cubes	4	65	19	8	2	2	192
		Chipped	1	56	18	14	4	7	73
		Both	3	63	19	10	2	3	265
	Service	Cubes	5	40	20	15	6	15	96
		Chipped	0	20	16	32	24	8	25
		Both	4	36	19	18	10	13	121
Total of all ice	Machine & Service Bin	Cubes & Chipped	3	54	19	12	5	7	386

paint flakes, fibers, paper, insect parts, and plastic and foam chips; and *(c)* a positive correlation was observed between high sediment levels and the subjective evaluation of the sanitary level of the ice making equipment by the field sanitarians.

Although the bacterial content of the ice produced by the on-the-premise ice making machines and served or sold as a food material in the establishments studied was relatively low, ice will harbor mesophilic, psychrophilic and coliform bacteria. Ice can potentially transmit harmful organisms and its sanitary quality should be under constant surveillance just as any other food product. It is important that bacterial examination of ice should be supplemented with sediment tests to insure against environmental foreign matter which appears in many samples.

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SALMONELLA NO PROBLEM IN AGED CHEDDAR CHEESE

Consumers don't need to fear *Salmonella-type* food poisoning from Cheddar cheese—especially if it has been aged a few months.

Even when milk has been contaminated with *Salmonella* organisms, the organisms don't survive the aging of the cheese, according to research of J. M. Goepfert, N. F. Olson and E. H. Marth of the University of Wisconsin.

Salmonella organisms cause an uncomfortable but usually non-fatal type of food poisoning. They can occur in eggs, other foods, and occasionally in raw milk. The researchers wanted to know what happens to the organisms when the contaminated milk is made into Cheddar cheese. They added small numbers of *Salmonella* to pasteurized milk and then made batches of Cheddar cheese using the stirred curd procedure.

By examining samples of the cheese at various stages during manufacture, they found out how the *Salmonella* organisms were surviving at each stage. Goepfert outlined the growth cycle as follows:

Milk coagulation results in a ten-fold increase in *Salmonella* population over that in the raw milk. The microbes become trapped in the curd which has been reduced to only one-tenth the volume of the milk. The reduction in volume concentrates the bacterial population.

When the bacteria multiply during coagulation and subsequent cheesemaking their population increases 30 times over that of the raw milk.

But then the situation changes. Addition of salt to the cheese slows down bacterial reproduction and finally stops it. During ripening at low temperatures, the *Salmonella* organisms continue to decrease until they reach less than one per cent of their peak papulation.

Further aging and storage practically rids the cheese of any remaining Salmonella organisms. When the cheese is stored for 4 months at 45 F, or for 3 months at 55 F, no *Salmonella* remain.

Goepfert tried to answer the question of why the organisms die during storage. He and his colleagues learned that a little acetic acid drastically cut down growth and reproduction of *Salmonella*. They think that the free fatty acids that accumulate in cheese during ripening have somewhat the same effect as acetic acid.

The acid, along with low moisture, high salt content, and low acidity, probably work together to make the lethal conditions that destroy any *Salmonella* bacteria that may be present in the cheese.

AFLATOXIN FOOD POISON

Two molds that produce a food poison called aflatoxin can grow on a protein "diet," even when strong acids or bases are added. The molds apparently adjust to their new chemical environment.

E. H. Marth, University of Wisconsin food scientist, recently reported his research on the rare poison.

Aflatoxin is a new food-poisoning problem, first noted in 1960. It is produced by at least two common molds. The poison has not been a threat to human health so far, but food scientists want to know what conditions are needed for its survival.

Marth and J. L. Lie tested two aflatoxin-producing molds, *Aspergillus flavus* and *Aspergillus parasiticus*, for their tolerance of acidic or alkaline conditions. They found that the molds tolerate acidity from pH 1.7 to pH 10.

The food researchers believe that the molds tolerate acidity either by using up the excess acid or by producing an alkaline substance to neutralize it.

Similarly, when the environment is alkaline, the mold may produce acids to neutralize the bases so the mold can continue to grow.

Marth is continuing his analysis of factors that affect the ability of *Aspergillus* molds to survive and make toxins. He hopes to learn more about the mold's growth habits in a variety of environments.

FLOW CHARACTERISTICS IN HOLDING TUBES OF COMMERCIAL EGG PASTEURIZERS

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Abstract

Fluid flow theory, as related to the holding of egg products in continuous pasteurization operation, is discussed. The conditions for laminar, turbulent and transitional types of flow; the specific factors in holding tubes that may cause deviations from the anticipated type of flow; and the effects of the viscosities of egg products are outlined. Retention times for laminar flow and the effects on survival of microorganisms are evaluated.

Determination of minimum holding times in 10 commercial holding tube arrangements with varying egg products were made. All minimum holding times were appreciably less than average holding times but more than would be predicted from simple laminar flow theory. Holding tube efficiencies varied roughly from 60 to 80%. They increased slightly with increased Reynolds numbers over the range of the latter that is found in commercial holding tubes.

For pasteurization of egg products a system is desired in which all particles get as nearly the same thermal treatment as possible. Fluid flow theory, however, indicates that all liquid in holding tubes does not move through the tube at the same velocity. Slower moving material will be overheld and may be heat damaged while fast moving material may not be adequately pasteurized. This report will describe considerations that relate to the flow properties of egg products and results of measurements of minimum residence times (time the fastest moving particle is held) compared to the average residence times for egg products in commercial pasteurizing equipment.

Fluid Flow Theory

The flow of liquids in tubes may be either laminar, turbulent or transitional between these types of flow *(1)*. In ideal laminar flow the lines of flow are maintained downstream and the material in each line retains its identity. The lines of flow are commonly, but not necessarily straight, parallel, and steady. Laminar flow in straight, circular pipes may be visualized as many infinitely thin, concentric cylinders of fluid. The cylinder next to the pipe wall is considered stationary but each of the inner cylinders travels at higher and higher speeds as the center of the pipe is approached. In completely laminar flow in a straight pipe there is no mixing action perpendicular to the direction of flow. Longitudinal mixing exists because of the aforementioned differences in velocity among flow cylinders.

In turbulent flow the flow lines are broken and there is appreciable movement other than in the major direction of flow so that mixing is occurring continuously over the entire cross section of the flow.

Transition flow has some of the elements of both laminar and turbulent flow. In addition to the mixing parallel to the direction of flow that occurs in laminar flow, other mixing occurs. This mixing is not over the entire cross section of the pipe. One concept is a flow in which the material toward the center of the pipe has some turbulence and the material nearer the pipe wall is in laminar flow.

A dimensionless term, called the Reynolds number (Re), is used in studying fluid flow. For flow in straight, circular pipes

$$\mathrm{Re} = \frac{\mathrm{DV}p}{\mathrm{Z}} = \frac{4\ \mathrm{W}}{\pi \mathrm{DZ}}$$

where:

D = pipe diameter — ft
V = velocity of flow — ft/sec
p = fluid density — lb/ft^3
Z = fluid viscosity — lb/ft sec
W = mass rate of flow — lb/sec

For our use a more convenient formula *(4)* for Reynolds number is

$$\mathrm{Re} = \frac{6.31\ \mathrm{w}}{\mathrm{d}\mu}$$

where

w = mass flow — lb/hr
d = pipe diameter — inches
μ = fluid viscosity — cp

If the Reynolds number is below 2000, the flow is generally laminar. Depending on various factors, laminar flow may occur above this value. The transition to turbulent flow extends over an appreciable range with no well defined point as the start of the turbulent flow region. Some authors give a Reynolds number of 3000 to 4000 as the lower range of turbulent flow. In calculations of pressure drops in the pipeline, the transition zone is treated as part of the turbulent zone. This results in answers that are on the high side, thus providing a safety factor for the

uncertainty in the type of flow.

In turbulent flow the velocity is higher at the center of the tube also, but the continuous mixing that occurs normal to the direction of flow prevents material from staying in either the high or low velocity zones for a disproportionate part of the retention time. This assures a more uniform retention time and pasteurization for all of the material.

Another factor affecting the holding of product in a tubular pasteurizer is the return bends (usually two 90° elbows) at each end of the straight lengths of tubing. Theory and experimental work with fluids flowing in curved pipes or tubular coils show that a secondary circulation called the double-eddy or Dean effect occurs *(5)*. This circulation is created perpendicular to the forward flow by the high speed flow in the center going to the outside on a turn. It provides in laminar flows a mixing action perpendicular to the forward movement which should be an aid to uniform product holding.

Other factors affecting the flow characteristics in pasteurizers are the entrance effects to the straight lengths of tubing and turbulence caused by protrusions of the gaskets at each joint. The type of flow that exists at the entrance to a straight run of tubing tends to maintain itself. An appreciable part of the straight run may be required for fluid flow to come to its final state for the particular conditions in the tubing. Any protrusions into a flow stream tend to cause additional turbulence. Each turn on a conventional tube bank of a pasteurizer has 3 gaskets that extend inside the pipe.

Predominantly laminar flow in the holding tubes of a unit may be acceptable if the material that goes through faster can be held long enough to accomplish pasteurization and the slower material is not heat damaged. The velocity pattern across a tube with laminar flow is parabolic in shape with the maximum at the center. The velocity at any location may be approximated for many fluids by the following formula *(5)*:

$$\frac{v}{V} = 2\left[\,1 - \left(\frac{r}{R}\right)^2\,\right]$$

v = velocity at any radius
V = average velocity
r = radius of desired location
R = radius of pipe

At the center of the pipe where $r = 0$, the velocity is twice the average. Its retention time is one-half of the average. At the outer edge of the pipe, $r = R$ and the velocity is calculated to be 0.

The retention time for material at any radius can be determined by

$$\frac{v}{V} = \frac{T}{t}$$

where T = average time
t = time for material at any radius

The amount of material subjected to a given retention time may be calculated from its velocity and the area of the cross section covered by the material at the velocity. By use of this calculation the following formula may be derived *(2)*:

$$\frac{w}{W} = 1 - \left(\frac{T}{2t}\right)^2$$

where

$\frac{w}{W}$ = the weight fraction with a retention time of t or less

Fig. 1 shows this relationship.

By use of the above and the thermal death rate formulae the number of surviving microorganisms in any weight fraction may be estimated. Estimations show that in pasteurization with laminar flow if there are surviving organisms most of them will come through in the fastest 20% weight fraction. The time required for this fraction to come through is about 10% more than minimum retention time. This is a justification for accepting the comparison of minimum retention time with average retention time as a measure of holding tube efficiency.

From the formula for the Reynolds number it appears that viscosity can have a major effect on the type of flow. Egg products have a wide range of viscosities. Under plant processing treatments and pasteurization temperatures they vary from about 3 centipoises for egg white at pH 7 to 200 centipoises for salt yolk. With these values and the tube diameters and flow rates commonly used in commercial units, the Reynolds numbers range from the low end of the laminar flow range to the beginning of the turbulent range.

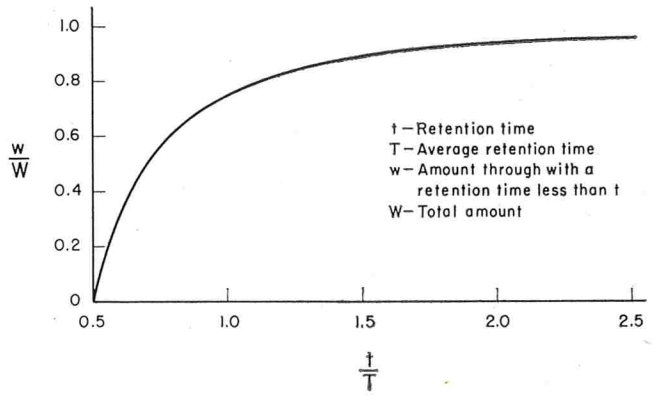

Figure 1. Retention time for laminar flow.

Another point that has been raised about egg products is their possible deviation from standard viscosity and flow properties and the effect of this deviation on holding times. Fluids may be classed as Newtonian or non-Newtonian. The viscosity of the first is independent of shear rate; of the latter variable with shear rate. A fluid flowing in a pipe is subjected to different shear rates at different points across the pipe so that the way the fluid flows in the pipe is affected by viscosity characteristics. Recent unpublished work by John Harper, University of California at Davis, indicated that the viscosity of various commercial samples of unfrozen egg products at pasteurization temperatures did not change greatly with changes in shear rate. Salt yolk showed the largest difference. Calculations based on data on this product indicated the minimum retention time would be longer by about 4% over the previously cited value for laminar flow (one-half of the average time).

METHODS

Runs in commercial units were made using the cold shot and fluorocarbon methods described earlier *(3)*. Thermocouples and thermistor units for the cold shot tests and injection and sampling ports for the fluorocarbon tests were installed with practically no change in piping arrangement. The by-pass loop and 4-way valve for the cold shot tests in some plants required some changes in the piping preceding the holding tubes. In no plant was it necessary to change the holding tubes or their arrangement. Plant pasteurizing procedures were not changed in any way.

Temperatures in most of the commercial pasteurizers are controlled so that the product leaving the holding tube is 1 F or more above the required pasteurization temperature. This provides a margin of safety if there is a small temperature drop in the product coming from the holding tube, and the automatic control equipment does not divert the flow back to the raw material feed tank. The cold shot method of testing causes a drop in product temperature but it was found that good trials could be made within this 1 F margin of safety. Of all the tests in commercial plants only three caused the flow to be diverted back to the feed tank, and one of these was caused by an incorrect diversion valve temperature setting. In some pasteurizers the temperature of the product leaving the holding tubes fluctuated 0.2 to 0.3 F resulting from cycling of the controls on the heat exchanger or heat losses from the holding tubes. In some tests these fluctuations prevented a good determination of the break in the temperature curve caused by the cold shot and these runs were repeated.

RESULTS

Table 1 is a summary of results from plant trials. Included in the egg products were two types of whites and two types of blends. The addition of peroxide to whites does not change the viscosity significantly but causes more gas to be present in the product in the holding tubes. The addition of lactic acid and aluminum sulfate to whites to attain pH 7 causes an appreciable drop in viscosity. One of the blends was whole egg with added yolk to attain 28% solids. The other included additional ingredients and had a solids content of 33%. Both blends had equivalent viscosities and should have similar flow properties. Tube diameter and the number of U-bends in the pasteurizer holding tubes give information on the general design of the unit. The type fittings used for the U-bends and the insulation, if any, varied among units. The operating data are averages from the number of runs indicated. Some individual runs are not included, primarily because of failure to show a definite break in the temperature curve of the product leaving the holding tubes.

One series of trials with nothing to be substituted salted yolk is not included. Minimum holding times were short and variable because an appreciable part of the volume of the holding tubes was occupied by foam caused by gases released from the hot product in the pasteurizer and possibly from some air being drawn in at the pump. By reducing the amount of air beaten into the product when the salt was added and primarily by keeping the pressure in the holding-tubes at not less than 20 lb. per sq. inch, the problem was alleviated. Consistent results were then obtained that were in agreement with data from other plants.

The temperatures of the product entering and leaving the holding tubes are the readings from thermocouples taken imediately prior to each test. Flow rates were determined by weighing product flowing directly from the pasteurizer for a brief period, usually 1 min, or by a count of number of cans filled over an extended period, at least 20 min; care was taken that the amount of product in the can filler was constant at beginning and end of the period.

The average holding time is calculated from the volume of the holding tube between the inlet and outlet sensing points, product density at room temperature and the pumping rate. True density of the product as it exists in the holding tube was not determined. Hot samples were taken at the end of the holding tubes and densities determined. Varying amounts of entrained bubbles occurred in these samples causing density variations as great as 10%. The volume occupied by these bubbles when the product was under pressure in the holding tubes could not be determined.

The minimum holding times shown in Table 1 were determined in most units by both the cold shot and flurocarbon methods except on whites where only the former was used. The addition of the yolk by the fluorocarbon test might have affected the functional properties of the whites. This test could be used on whites if the white containing the yolk was

TABLE I. SUMMARY OF PLANT TRIALS

Product	Pasteurizer	Tube diameter, inches	Number of U bends	Number of runs	To holding tubes - °F	From holding tubes - °F	Flow rate pound/hour	Average holding time-minutes	Minimum holding time-minutes	Holding tube efficiency-%	Range of efficiencies, %	Viscosity centipoise	Reynolds number
Whole egg	A	2.0	9	4	142.8	141.2	1900	4.00	2.89	72.2	70.5-74.5	9.9	670
	B	2.0	8	8	146.1	142.0	2530	4.23	3.12	73.8	72.1-75.7	6.0	1330
	C	2.0	10	8	146.2	142.7	4400	3.52	2.64	75.0	71.3-79.7	6.0	2310
	D	2.5	10	3	146.0	142.6	4500	5.34	3.92	73.4	71.8-74.5	6.6	1720
	E	3.0	8	3	144.0	142.4	8500	3.68	2.74	74.5	71.0-77.5	5.2	3440
										73.8	70.5-79.7		
Whites,	F	2.0	19	2	127.6	126.9	4380	3.75	2.71	72.3	71.2-73.3	5.0	2760
H_2O_2	G	2.5	18	1	130.0	128.2	6600	4.12	3.14	76.0	—	6.4	2600
pH 7	D	2.5	10	3	143.0	141.4	5400	4.44	3.62	81.6	81.0-82.8	3.3	4130
	G	2.5	18	2	145.5	143.2	6750	4.04	2.90	71.9	71.0-72.5	3.3	5160
										75.5	71.0-82.8		
Blends	H	3.0	4	4	144.7	142.1	4350	3.58	2.33	65.2	64.3-65.6	9.0	1020
	F	2.0	19	2	143.2	142.2	4560	3.66	2.70	73.8	73.0-74.6	9.0	1600
	G	2.5	18	2	145.5	142.7	6120	4.45	2.86	64.5	64.0-65.0	9.6	2010
										67.8	64.0-74.6		
Sugared	I	2.0	6	1	148.3	144.3	2460	6.53	4.20	64.3	64.3	—	—
Yolk	I	2.0	6	3	151.2	148.7	4460	3.60	2.20	61.2	60.5-61.8	—	—
										62.8	60.5-64.3	—	—
Salted	I	2.0	6	2	152.2	146.6	2460	4.00	2.46	61.5	60.5-62.5	130	60
Yolk	D	2.5	10	4	148.0	144.0	3180	8.06	5.41	67.2	62.0-71.4	220	36
	J	2.5	14	3	144.8	142.2	3720	5.00	3.77	75.4	75.0-76.0	200	47
										68.0	60.5-76.0		

adequately diluted with other white or blended into whole egg. Lipase could also be used to convert the function-damaging fat of the yolk to glycerol and fatty acids which do not affect the functional properties of whites.

Holding tube efficiencies are the ratio, expressed as per cent, of minimum holding time to average holding time. The range of efficiencies are for the individual trials in the series of tests for each pasteurizer.

Viscositiy values were obtained with a Brookfield[1] viscometer (Model LVF with adapter for low viscosity materials) on the hot product drawn from the discharge end of the holding tubes. The temperatures at which the measurements were made were down about 10 F from those in the tubes, giving a somewhat high viscosity figure, but adequate for this purpose.

[1]Reference to a company or product name does not imply approval or recommendation of the product by the U.S. Department of Agriculture to the exclusion of others that may be suitable.

Reynolds numbers were calculated by use of the previously cited equation.

DISCUSSION AND CONCLUSIONS

Data presented in Table 1 show that most of the plants were operating appreciably above the required holding temperatures and times. The high temperatures of the product entering the holding tubes would not be necessary with better insulation or control of the temperature of the air around the holding tube. Average holding times were quite variable between pasteurizer units and within some plants when processing different products.

The results of the tests for minimum holding times show that in all units and for all products some material is going through the holding tubes in considerably less than the average holding time, but the fastest material is not going as fast as would be predicted on the basis of simple laminar flow in straight tubes. Holding tube efficiencies in the various units ranged roughly from 60 to 80%, whereas the holding tube efficiency in fully developed laminar flow is 50%.

There is only a slight increase in holding tube efficiencies with increased Reynolds numbers over the

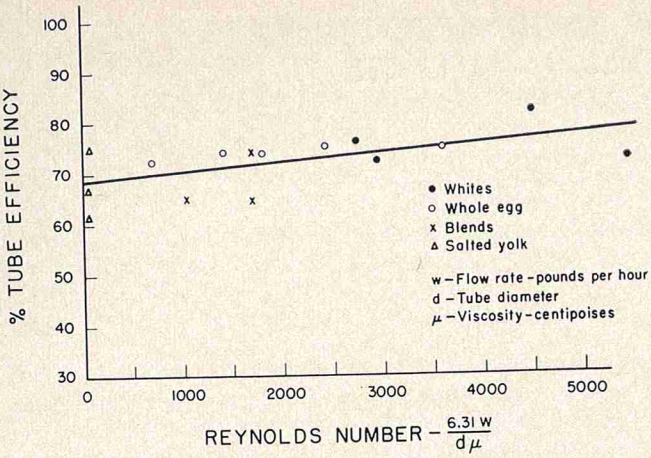

Figure 2. Holding tube efficiencies vs. Reynolds numbers.

range of Reynolds numbers found in commercial egg pasteurizers (Fig. 2). There is apparently as much variation caused by factors other than those in the Reynolds number, although no other specific factor was found that correlates with holding tube efficiency.

ACKNOWLEDGEMENT

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NEW PROTEIN FOOD MEETS HUNGER NEEDS IN DEVELOPING COUNTRIES

The protein malnutrition among people in developing countries may not be an unsurmountable problem as more efforts are launched to provide the needed protein in a practical and low-cost way. A report on such an effort in Colombia was given recently by John C. Hussey, Jr., of The Quaker Oats Company.

In 1963, after half a century of exporting tinned oats to Latin America, Quaker Oats began production of a food composed of local ingredients and containing a higher percentage of protein than the 17% in oats.

The formula for the high-protein food was developed by the Institute of Nutrition of Central America and Panama (INCAP) and is called Incaparina. It contains corn flour, soy flour, cottonseed flour, calcium carbonate and some vitamin fortification. Local ingredients make up over 98% of the total.

The high-protein, floury Incaparina is appropriate for making coladas, a thin gruel eaten or drunk in Colombia by all age groups, particularly by people in the middle and lower classes.

A Quaker Oats subsidiary in Colombia manufactures and markets the product. A low shelf price is considered an important factor. The price is held down to two Colombian pesos per 500 bag, amounting to 12 cents in U.S. currency for 20 to 25 portions of Incaparina.

Distribution is concentrated among outlets in the lower class areas. Advertising stresses that Incaparina's high protein content can make the difference between malnutrition and good health.

Not only the quantity of protein, but the amino acid balance, by which the quality of the protein is judged, is comparable in Incaparina and powdered whole milk says Hussey, who is director of marketing for the Quaker Oats Latin American and Pacific Operation. He advises that Incaparina provides the approximate nutritional equivalence of powdered whole milk at one-tenth the price per g.

Sales of Incaparina in the last fiscal year amounted to slightly over 1500 tons. This represented an increase of 50% over the previous fiscal year's sales. That amount of sales will make about 60 million glasses of the gruel drink, equivalent to as many glasses of milk. The bulk of this protein is being made available to Colombians who would otherwise be deprived of it because of cost.

Quaker Oats is in the process of extending sales of their high-protein product outside Colombia and are in the initial stages of an Incaparina test market in Nicaragua.

KEEPING QUALITY OF DAIRY PRODUCTS OBTAINED AT RETAIL OUTLETS II. WHIPPING CREAM AND HALF AND HALF[1]

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Abstract

A study was made of the keeping and bacteriological qualities of whipping cream and half and half obtained from retail outlets. The samples ranged in age from 2 to 28 days at time of purchase, the average being 7.7 days (whipping cream) and 6.4 days (half and half). The average number of days held after purchase at a temperature of 5 ± 0.5 C was 6.2 days (whipping cream) and 5.8 days (half and half). Only 9% of the half and half samples had a satisfactory flavor score (36.0 or higher) after storage for 14 days at 5 ± 0.5 C, whereas 22.5% of the whipping creams had satisfactory flavor after this storage period. The quality of products of individual brands tended to be similar; whereas, significant quality differences were observed between brands.

Sale of substitute dairy products is creating one of the most serious threats ever to face the Dairy Industry. In some markets, these products account for nearly 10% of total dairy type sales. Price alone will not account for the increased popularity of the substitute products. Consumer experience with dairy product quality also is playing an important part in sales. The industry must take a "hard" look at the quality of dairy products being sold before this challenge can be met. One of the ways the industry can meet this challenge is to insure that the consumer receives only high quality products with a long shelf life.

Studies have shown that the quality of fluid milk reaching the consumer has not been consistent and that significant quality differences exist between brands and processors *(2, 3, 4, 5)*.

This study was undertaken to obtain more information relating to the keeping and bacteriological qualities of various fliud dairy products obtained at retail outlets.

Experimental Procedure

Sampling

One-half pint samples of whipping cream and pint samples of half and half from 7 commercial plants, representing 9 and 10 brands respectively, were obtained from retail outlets in Lexington, Kentucky, between February, 1966 and October, 1967. Samples were obtained from the front of the display case and taken immediately to the laboratory for examination. From the code numbers on the samples, processing dates were obtained from the plants.

Flavor evaluation and keeping quality

All flavor evaluations were made by a panel of at least 2 judges experienced in the scoring of dairy products. Samples with a flavor score of 36.0 or less by the American Dairy Science Association student score card were considered to be unacceptable. Flavor examinations were made on the day purchased and after 4, 7, 10 and 14 days of storage at 5 ± 0.5 C.

Bacteriological examination

Official procedures *(1)* were used for standard plate counts (SPC) and coliform counts (CC) with incubation at 32 C.

Plates for psychrophilic counts (PC) were incubated at 5 C for 7 days. The samples were plated on the day purchased and again after storage for 7 days at 5 ± 0.5 C.

Results and Discussion

Whipping Cream

A summary of results obtained with the whipping cream samples is given in Table 1. At the time of purchase flavor scores ranged from 30.0 to 40.0 and averaged 38.1. Products of Brand A had the lowest flavor score (average 36.3), whereas those of Brand E were highest (average 39.3). The main flavor defects encountered were: cooked, stale, "high fortification," sour, putrid, and malty.

The age of the products at the time of purchase ranged from 2 to 28 days, the average being 7.7 days. Variation between brands was considerable as can be seen from the data. This variation probably, in part, resulted from popularity of the brand and type of outlet.

The term "days kept" represents "home" keeping quality or time the product remains usable after purchase by the consumer. With the exception of one brand (Brand E) there was a remarkable consistency in "home" keeping quality of the whipping creams—all of it poor. The data indicate that few samples were usable 14 days after purchase and more than half (55.9%) were unusable 7 days after purchase. Brand E, however, while the oldest at the time of purchase, held up well with only 2 samples becom-

[1]The investigation reported in this paper (no. 67-4-140) is in connection with a project of the Kentucky Agricultural Experiment Station and is published with approval of the Director.

TABLE 1. KEEPING AND BACTERIOLOGICAL QUALITY OF WHIPPING CREAM OBTAINED AT RETAIL OUTLETS[a]

Brand	Purchase age (Days)	Days kept[b]	Total days kept[c]	Initial flavor	Coliform count >10/ml		Standard plate count >20T/ml		Psychrophilic count >1000/ml		Flavor score less than 36.0 Days[e]				
					0 days	7 days[d]	0 days	7 days[d]	0 days	7 days[d]	0	4	7	10	14
	Average				Number of Samples										
A	8.6	5.3	13.9	36.3	4	6	2	10	6	9	2	4	6	7	8
B[f]	8.6	5.3	13.9	37.1	1	2	5	9	7	10	1	2	7	7	7
C	5.1	6.8	11.0	38.6	2	4	3	8	4	9	0	1	4	8	8
D	7.7	4.3	12.0	38.6	4	7	6	10	9	10	0	3	7	8	10
E	11.5	12.6	24.1	39.3	0	1	1	5	3	5	0	0	1	1	2
F	6.4	6.7	13.1	38.8	1	2	3	9	4	9	0	1	4	7	9
G	9.0	3.6	12.6	37.7	4	7	7	9	8	10	1	5	8	8	9
H	6.2	6.8	13.0	38.4	1	2	1	9	6	10	1	2	5	7	7
I	6.5	4.0	10.5	38.3	2	4	5	9	6	10	0	4	7	9	9
Avg.	7.7	6.2	13.9	38.1	—	—	—	—	—	—	—	—	—	—	—
%	—	—	—	—	21.3	39.3	37.1	87.6	59.6	92.1	5.6	24.7	55.9	69.6	77.5

[a]represents 10 samples per brand
[b]from date of purchase
[c]from date of processing
[d]after 7 days storage at 5 ± 0.5 C
[e]storage at 5 ± 0.5 C
[f]only sampled 9 times

ing unusable before the 2 week holding period was completed. This product also had the highest initial flavor score.

The bacterial quality of the samples of the various brands closely followed the keeping quality pattern. Table 1 shows that Brand G which had the poorest keeping quality also had the greatest number of samples exceeding the legal maximum coliform and standard plate counts. It also had a large number of samples with relatively high psychrophilic counts at all times of plating. On the other hand, Brand E was outstandingly superior to the others in bacterial quality.

Half and Half

A summary of results obtained with the half and half samples is given in Table 2. As with the whipping cream, flavor scores ranged from 30.0 to 40.0 at the time of purchase and averaged 38.3. For the most part, average scores between brands were similar except for the poorest brand (Brand D), which had an average score of 36.7 and the best brands (Brands E and G) with an average of 39.2. The flavor defects were the same as those noted for whipping cream.

This product appeared to move from the store at a somewhat more rapid rate than did the whipping cream. Range in age was from 2 to 17 days at the time of purchase, some 10 days less than the extreme for whipping cream. Average age was 6.4 days at the time of purchase which was over a day less than for the higher fat product.

In general, the "home" keeping quality of the half and half samples were poorer that of the whipping cream samples. Brand D remained usable only 1.2 days, on the average, after purchase whereas Brand C remained satisfactory for an average of 10.4 days. Few samples (less than 10%) remained usable 14 days after purchase and over half (51%) were spoiled 7 days after purchase.

The brand with the least number of samples exceeding the bacterial standard both at time of purchase and after 7 days was Brand H. The coliform count was completely negative at time of purchase, only 1 sample exceeded the legal standard plate count, and only 1 sample had any appreciable number of psychrophiles. However, while this product had the second best keeping quality from time of production, only one of its samples kept 14 days in storage in the laboratory. Over half of the samples of Brand D exceeded the bacterial standard at time of purchase and all were unsalable after storage for 7 days in the laboratory.

Interestingly, none of the "home" keeping problems associated with half-and-half seem to be related to age at time of purchase. Brand E was the oldest

at time of purchase and had the second best "home" keeping time. Except for Brand C, the brands (G, I and F) with the poorest "home" keeping quality had been in the stores the shortest period of time.

General Observations

A summary of the results obtained in this study and in earlier trials (3, 5) is presented in Table 3. These data represent the results obtained from the examination of 622 product samples.

From a study of this table, it can be seen that quality varies with the different products and, in general, the bacteriological quality decreases with an increase in butterfat content. Not shown by this table is the observation that if one product of a brand had a good keeping quality, other products of that

TABLE 2. KEEPING AND BACTERIOLOGICAL QUALITY OF HALF AND HALF OBTAINED AT RETAIL OUTLETS[a]

Brand	Purchase age (Days)	Days kept[b]	Total days kept[c]	Initial flavor	Coliform count >10/ml		Standard plate count >20T/ml		Psychrophilic count >1000/ml		Flavor score less than 36.0 Days[c]				
					0 days	7 days[d]	0 days	7 days[d]	0 days	7 days[d]	0	4	7	10	14
	Average				Number of Samples										
A	7.9	6.2	14.1	38.1	3	7	4	10	5	8	1	2	3	7	10
B	7.1	5.6	12.7	37.4	0	1	1	9	5	9	0	2	4	8	10
C	3.9	10.4	14.3	38.8	0	3	1	6	0	6	0	0	2	2	6
D	7.9	1.2	9.1	36.7	6	10	7	10	8	10	2	7	10	10	10
E	8.2	9.3	17.5	39.2	0	1	0	9	1	9	0	0	1	4	8
F	5.3	5.3	10.6	38.6	0	3	1	9	3	8	0	3	6	7	9
G	5.4	2.7	8.1	39.2	1	6	6	10	5	10	0	4	5	10	10
H	6.9	7.4	14.3	38.5	0	0	1	8	1	7	0	0	4	6	9
I	4.5	3.4	7.9	38.4	4	8	4	10	5	10	1	3	8	10	10
J	6.5	6.8	13.3	38.5	0	1	4	10	2	8	0	3	4	4	9
Avg.	6.4	5.8	12.2	38.3	—	—	—	—	—	—	—	—	—	—	—
%	—	—	—	—	14.0	43.0	29.0	91.0	35.0	85.0	4.0	24.0	51.0	68.0	91.0

[a]represent 10 samples per brand
[b]from date of purchase
[c]from date of processing
[d]after 7 days storage at 5 ± 0.5 C
[e]storage at 5 ± 0.5 C

TABLE 3. COMPARISON OF THE KEEPING AND BACTERIOLOGICAL QUALITY OF SIX FLUID DAIRY PRODUCTS OBTAINED AT RETAIL OUTLETS

Product	No. of samples	Purchase age[a]	Days kept[b]	Total days kept[c]	Initial flavor	Coliform count >10/ml		Standard plate count >20T/ml		Flavor score less than 36.0 Days[c]				
						0 days	7 days[d]	0 days	7 days[d]	0	4	7	10	14
Homogenized Milk	144	3.9	7.7	11.6	37.9	5.6	16.7	13.2	—	6.9	16.9	31.2	57.6	73.6
Skimmilk	100	5.3	8.0	13.3	38.3	2.0	20.0	12.0	72.0	3.0	9.0	26.0	57.0	79.0
Low-fat Milk	90	4.3	9.5	13.8	38.5	3.3	14.4	11.1	60.0	0.0	4.4	21.1	38.9	62.2
Chocolate-flavored Milk	99	5.9	6.0	11.9	38.0	8.1	21.2	33.3	89.9	4.0	21.2	43.4	73.7	92.9
Whipping Cream	89	7.7	6.2	13.9	38.1	21.3	39.3	37.1	87.6	5.6	24.7	55.0	69.6	77.5
Half and Half	100	6.4	5.8	12.2	38.3	14.0	43.0	29.0	91.0	4.0	24.0	51.0	68.0	91.0

[a]represent 10 samples per brand
[b]from date of purchase
[c]from date of processing
[d]after 7 days storage at 5 ± 0.5 C
[e]storage at 5 ± 0.5 C

same brand were usually of comparable quality. The converse was also true; if one product of a brand was poor in flavor, keeping quality, or bacteriological profile, then all products of that brand would be poor.

The average age at the time of purchase for all products ranged from a low of 3.9 days for homogenized milk to a high of 7.7 days for whipping cream. Even the poorest keeping quality from time of processing averaged over 11 days and yet relatively few samples survived storage after purchase of 14 days.

Based on these data, a processor easily could be misled if he considered only the keeping quality of his products as determined at the plant or by bacteriological examination on the day processed. Based on these data, it is shown that products of low "turnover," i.e. whipping cream, and half and half, have a good total keeping quality but do not keep very long after purchase. It would appear that a manager could profit by giving more attention to products of his plant at the retail level. This is where the consumer meets the product. Some suggested means of care are: better coding systems, education of the driver in rotation of the products, education of store personnel in passing on complaints, and routine check of retail products by laboratory personnel.

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MILK COMPOSITION ALERTED BY MSU DAIRY SCIENTISTS

There's no real sense in arguing with a cow about the kind of milk she'll give. But dairy nutrition research at Michigan State University shows that milk composition can be changed to fit changing economic and nutritional needs.

"While other kinds of pricing methods have been proposed, butterfat content still determines much of the farmer's milk price," said MSU researcher Dr. J. T. Huber. "So research on the effect of feed additives on butterfat has some real economic importance," he said.

"Under certain conditions dairy herds, or individual cows, are on restricted roughage rations," Huber stated, "and this depresses butterfat."

In the research reported by Dr. Huber, with Drs. C. E. Meadows, J. W. Thomas and R. S. Emery, Holstein cows were fed all the grain they could eat, a limited amount of hay, minerals (sodium bicarbonate and mangesium oxide) and partially delactosed whey (whey from which some lactose or "milk sugar" was removed).

All cows in the experiment averaged 3.5% butterfat before trial feeding began. Milk fat went down to 2.4% from cows on a restricted roughage ration of 5 lb. of hay and free-fed concentrate. This reduction may be worth over 70 cents a hundred to the dairyman.

When 14% whey or minerals were added to the concentrate, butterfat increased to over 3%.

In companion research, Emery looked at the mechanisms involved in milk composition. With Drs. Huber, Thomas and post-doctoral student Dr. I. M. Yousef, Emery reported that minerals and whey stimulated fat transfer from blood to milk.

Dr. Emery mentioned that in early milk composition work, they literally "tickled the spit" out of cows to overcome butterfat depression on restricted roughage diets. They noted that roughage stimulated salivation. The saliva contained $NAHCO_3$ (bicarbonate of soda) which seemed to increase butterfat in milk. So they fed brushes to cows in an effort to stimulate salivation and compensate for missing roughage. Biggest drawback was that cows didn't like it much.

Next approach was adding the mineral to feed, the basis for the current research program.

In another study on the effect of rations on milk protein synthesis Drs. Yousef, Huber, Emery and Thomas noted that protein increased in milk from cows on the high grain, low roughage diet.

"High grain (energy) rations apparently increased the protein synthesizing apparatus in mammary cells," Yousef reported.

THE OXIDASE REACTION IN RELATION TO FLAVOR QUALITY OF GRADE A PASTEURIZED MILK[1]

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ABSTRACT

An oxidase reaction with tetramethyl-*p*-phenylenediamine hydrochloride was carried out in 50 samples of Grade A pasteurized milk. With a majority of the samples a negative oxidase reaction or a change from positive to negative indicated that the flavor score was unacceptable or soon would reach that level.

The shelf life of many foods including milk is determined largely by the initial level of microbial population, the ability of these organisms to grow under the conditions of storage, and their biochemical activities, primarily proteolytic and/or lipolytic action. A low initial population level of bacteria capable of growing rapidly at refrigeration temperatures and producing proteolytic and/or lipolytic changes in a food likely affects the keeping quality to a greater extent than a similar population composed of biochemically inert organisms or a somewhat larger initial population but predominantly non-psychrophilic in nature. Neither the standard plate count nor the psychrophilic plate count provides information about the biochemical activities of a microbial population. Although the psychrophilic plate count of a food is an indication of the level of population capable of growing at refrigeration temperature, plate incubation times of 7 to 10 days usually are required. An excellent discussion of the relative value and limitations of the total count as an index of food quality was presented by Silliker *(13)*.

In milk stored under refrigeration gram-negative psychrophilic bacteria are the principle cause of flavor defects of microbial origin. In the development of tests for keeping quality, various investigators have used different techniques to enumerate this particular population or measure its activity. Selective plating media with chemicals to inhibit gram-positive bacteria have been used *(10, 12, 15)*. These compounds include crystal violet, brilliant green and Nacconal. Other workers added oxidation-reduction indicators directly to the milk. Reduction times then were related to keeping quality, the samples with the longer reduction times usually exhibiting better shelf life. With milk, Hiscox et al. *(5)* used methylene blue with incubation at 15.5 C. Broitman et al. *(2)* employed triphenyltetrazolium chloride with added Nacconal to inhibit gram-positive bacteria. For shelf life estimations of poultry meats Walker et al. *(16)* and Wells *(17)* used resazurin reduction tests. In another approach, the increase in plate count after a "preliminary incubation" of a milk sample at 7 to 13 C was used as an indication of potential psychrophilic growth *(6-8)*. To predict shelf life and possible spoilage pattern of food, Vanderzant and Patel *(15)* recommended a quantitative analysis of the microbial flora together with information on the biochemical activities of the various types of bacteria in the population. Colonies appearing on agar plates after surface plating were subjected to various rapid biochemical tests for identification. One of these tests, the oxidase reaction of Kovacs *(9)* and Steel *(14)* is a very useful taxonomic tool in food microbiology to separate the oxidase-positive *Pseudomonadaceae* from the oxidase-negative *Enterobacteriaceae*. The reaction is based upon the ability of certain bacteria to produce indophenol by the oxidation of dimethyl-*p*-phenylenediamine hydrochloride (DMPD) and *a*-naphthol. Gordon and McLeod *(4)* determined the oxidase activities of colonies by bringing them in contact with a 1% solution of DMPD and subsequently exposing them to air. The dye is rapidly oxidized through a red to black color in 10-30 min. In subsequent studies Ellingworth et al. *(3)* used tetramethyl-*p*-phenlyenediamine hydrochloride (TMPD). This compound is less toxic than DMPD and is easily oxidized in the air to a blue-violet compound sometimes called "Wurster's blue." This blue oxidation product, however, can be reduced to a colorless compound by bacteria whereas the black product formed from DMPD does not undergo further changes. In the oxidase test as described by Steel *(14)* bacterial growth is picked from the plates and rubbed on filter paper impregnated with a 1% (w/v) aqueous TMPD solution. Production of a purple color within 10 sec is recorded as positive. The filter paper can also be placed on top of colonies on the agar plate in order to separate oxidase-positive from oxidase-negative bacteria. This paper de-

[1]Technical Paper No. 7363 of the Texas Agricultural Experiment Station, College Station.

TABLE 1. FLAVOR SCORES AND OXIDASE REACTION OF 50 SAMPLES OF GRADE A PASTEURIZED MILK

Sample no.	Initial flavor score	Day of change, oxidase reaction	Daily flavor scores with changes in oxidase reaction: Ox. (pos.)	Red. (neg.)				Sample no.	Initial flavor score	Day of change, oxidase reaction	Daily flavor scores with changes in oxidase reaction: Ox. (pos.)	Red. (neg.)				
1	39	4	37	37	32			26	38.5	7	36	36	31			
2	38.5	8	37	37	35	34	31	27	39	10	35	35	35	35	ns	
3	ns[a]	0	—	ns				28	39	13	35	31				
4	39	0	—	39	33	31		29	38	3	38	38	35	35	ns	
5	39.5	4	37	36	35.5	32		30	31	0	—	31				
6	ns	0	—	ns				31	39	6	36.5	36	35	ns		
7	39	2	38.5	38	ns			32	38.5	2	38.5	37	31			
8	38.5	2	38.5	38	31			33	39.5	0	39.5	37	37.5	ns		
9	ns	0	—	ns				34	39	0	39	39	31			
10	38.5	3	37	37	ns			35	39	0	39	39	31			
11	37.5	5	35	35	ns			36	39	0	—	39	31			
12	39.5	2	39.5	34	34	34	ns	37	39	9	35	34	ns			
13	37	3	37	37	36	31		38	39	0	39	39	31			
14	31	0	—	31				39	39	8	35	35	34	ns		
15	39	3	38	37.5	31			40	39	0	39	39	35	31		
16	37.5	6	36.5	ns				41	38	0	—	38	31			
17	38.5	3	37.5	37.5	ns			42	38.5	4	38	35	35	35	35	ns
18	38	3	37.5	37.5	36	ns		43	38	0	38	31				
19	39	5	37	32				44	38	0	—	38	35	31		
20	39	2	39	37	36	ns		45	38	0	—	38	31			
21	39	0	39	38.5	37	31		46	39	5	38	37.5	37.5	37.5	—	ns
22	31	0	—	31				47	39	10	37	36.5	—	—	32	ns
23	39	8	36	35	35	ns		48	37.5	0	—	37.5	37.5	37.5	37	ns
24	39	13	35	ns				49	39	2	39	39	38	38	—	ns
25	38.5	10	35	35	ns			50	39	7	38	37.5	—	37	—	ns

[a]ns = no score, product was considered of unsalable quality.

scribes experiments in which the oxidase reaction was carried out in milk samples rather than on isolated colonies.

EXPERIMENTAL METHODS

Grade A pasteurized milks were purchased in retail stores in the Bryan-College Station area and stored in the laboratory at 5-7 C. The flavor score of each sample was determined daily until the experiment was terminated. A score of 40 was considered excellent (no criticism), 38-39.5 good, 36-37.5 fair, and 35.5 or less as poor *(11)*. The oxidase reaction of each sample was determined daily as follows: to 10 ml of cold milk in screw-cap test tubes (145 x 15 mm) was added 1 ml of 1% aqueous TMPD solution. The tubes were inverted 3 times to mix milk and TMPD. The tubes were placed in a water bath at 30 C for 30 min. The water in the bath was about 2 inches above the contents of the tubes. The samples which showed a blue color (TMPD in oxidized state) were designated oxidase-positive, those which were white with or without a blue ring (2 mm) on top (TMPD in reduced state) were named oxidase-negative. The oxidase-positive samples usually showed some blue color after 5-10 min. The oxidase-negative samples remained white during the 30 min reaction period. In most of these a blue ring developed at the top of the sample. Preliminary experiments indicated that incubation periods longer than 30 min were not necessary. The blue color developed to its highest intensity during this period. The agar plate method was carried out as described in *Standard Methods (1)*.

RESULTS AND DISCUSSION

The principle flavor criticisms of the milks on day of purchase were cooked, lacks freshness, unclean, and oxidized. At the end of the experimental period, when many samples were unsalable, a majority was described as unclean, fruity, or putrid. The results on flavor scores and oxidase reaction of 50 samples of Grade A pasteurized milk are presented in Table 1. Information is presented on (*a*) initial flavor score (score on day of purchase), (*b*) time at which oxidase reaction of milk changed from positive to negative expressed in days since day of purchase, and (*c*) flavor scores at daily intervals starting with the day before a change in oxidase reaction occurred. For example, the flavor score of sample 1 on the day of purchase was 39. The oxidase reaction of the milk was positive for the next three days. After three days the flavor score had decreased to 37. On the fourth day the oxidase reaction was negative but the flavor score remained 37. On the fifth day, the flavor score dropped to 32 at which time the experiment was terminated. Sample 3 showed a negative oxidase reaction on the day of purchase. No flavor score was given because the product was con-

sidered unsalable. In order to facilitate a discussion of the results, a flavor score of 35 or lower was considered poor and undesirable. Six of the 50 samples had a score of less than 35 on the day of purchase. These samples showed a negative oxidase reaction. Of the 44 samples with an acceptable flavor score on the day of purchase, 31 (for example, samples 1, 2, 4, 5, etc.) showed a change in the oxidase reaction (from positive to negative) before the flavor score dropped to 35 or below. In six (samples 12, 16, 19, 23, 42, 43) a change in oxidase reaction occurred on the same day that the flavor score changed from acceptable to unacceptable. The remaining seven samples (no. 11, 24, 25, 27, 28, 37, 39) showed a positive oxidase reaction and had a flavor score of 35. Six of these milks exhibited a pale blue color after incubation for 30 min at 30 C. In future work it may be advisable to establish a color standard and assign these samples to a class of "doubtful positive." Under these conditions only sample no. 11 would have shown a definite positive oxidase reaction and an unacceptable flavor score. However, even in this instance a change in oxidase reaction occurred when a significant change in flavor score (35 to no score) took place. An examination of the flavor criticisms showed that each of these seven borderline samples was criticized as oxidized (stale) before and after a change in oxidase reaction occurred. The possibility exists that oxidative products associated with changes in the milk lipids may have interacted with the oxidase reaction.

In addition to flavor score and oxidase reaction, standard plate counts were determined daily on 25 milks. The oxidase reaction changed from positive to negative with a viable population ranging from 7×10^6 to 7×10^7 per ml. With a majority of the milks (43 out of 50) a negative oxidase reaction or a change from a positive to a negative reaction indicated that the flavor score was already unacceptable or soon would be unacceptable. The term "unacceptable" as used here is associated with a flavor score of 35 or lower and is used only for the sake of convenience.

The following observations pertain to the mechanism(s) responsible for the reaction of TMPD in milk. Freshly pasteurized milk always appeared strongly oxidase-positive. Oxidase-negative milks were colorless from the beginning of the 30 min incubation period and only a thin blue layer (2 mm) developed on the top of the sample as the incubation period progressed. This oxidase-positive ring probably developed there because oxygen was readily available to the milk–TMPD system. The reduction to a leuco form of TMPD in some milks probably resulted from lowering the oxidation reduction potential as a result of bacterial action. The reaction in milk is somewhat different from that observed on agar plates flooded with TMPD. Colonies of common spoilage bacteria such as *Pseudomonas*, *Alcaligenes*, and *Achromobacter* oxidize TMPD to a blue-purple color. After standing for some time (5-10 min or longer), however, they also reduce the compound so that the color fades away. The limited data do not justify any firm conclusion about the usefulness of the oxidase test to determine the effect of microbial activity on the flavor of milk or to determine or predict shelf life of pasteurized milk. However, the data presented here warrant further investigations on the use of the oxidase reaction as a test to determine the keeping quality of pasteurized milks.

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LETTER TO THE EDITOR

(Editors Note: Sanitarians and other readers of this Journal are invited to report their observations, experiences, and data using the "Letter to the Editor" when this approach appears preferable to a complete scientific paper.)

Quality of Hamburger Improved in Waterloo, Iowa

DEAR SIR:

I recently carried out an extensive test of bacteria in hamburger in the city of Waterloo, Iowa. This program was initiated because of various food poisoning reports and periodic sanitation inspections which indicated poor sanitation methods.

One pound samples of hamburger from retail stores and hamburger patties from drive-ins and restaurants were submitted to the city laboratory. These samples were kept refrigerated during transit. Eleven grams were weighed out into a blender and diluted with 99 ml sterile H_2O. From this dilution 1:1000 dilutions were made.

The samples were plated on Standard Methods Tryptone Glucose Yeast Agar and plates were incubated at 32 C for 48 hr.

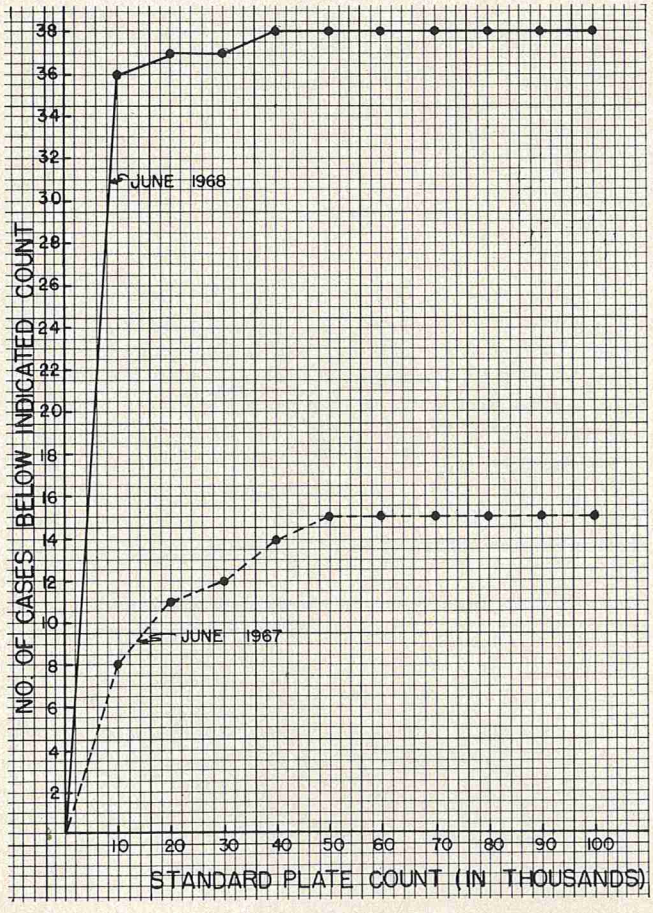

Figure 1. Standard Plate Count results on hamburger before (1967) and after (1968) initiation of a sanitation program.

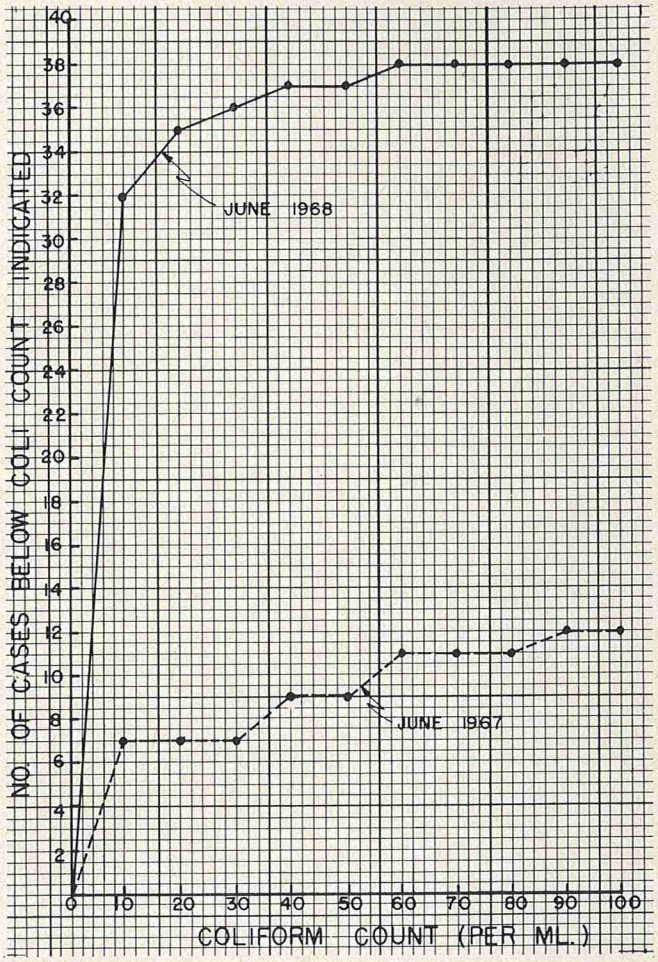

Figure 2. Coliform count results on hamburger before (1967) and after (1968) initiation of a sanitation program.

The coli plates were also inoculated from the 1:1000 dilution using 1 ml per plate. Violet red bile agar was used and plates incubated at 32 C for 18 hr.

The figures show the Standard Plate Count (Fig. 1) and the coliform count (Fig. 2) for June of 1967 and 1968. Results for the initial tests during the few months prior to June, 1968 are not shown since they resemble the form of the June, 1967 figure. It should be noted however that the median on initial tests was approximately 2.5 million for the Standard Plate Count and 1,100 per g for the coliform count. The June, 1968 figures represent the initial results of the increased sanitation efforts. The results are indeed significant. The median for the Standard Plate Count has been reduced to 10,000 per g from the 2.5 million mark. No less startling, the median coliform count is less than 30 per g.

Why did these counts drop so significantly? The periodic inspections referred to previously revealed both major and minor faults concerning sanitation.

In a few instances the complete absence of hot water and disinfectant were pointed out. Many times when hot water was present, the temperature was too low. Disinfectant was often improperly and infrequently used. The frequently used meat blocks were only seldom scraped and disinfected.

Personal cleanliness was revealed through smear tests and swab tests indicated the condition of equipment, meat hooks, etc. Refrigeration units were often dirty and the cooling apparatus of many display cases were often so covered with dirt and other material that they simply couldn't operate efficiently. The list could go on but an explanation of the methods used to rectify the situation will serve a better purpose.

The first step taken was to explain the benefits of a good quality sanitation program to the owner or operator. Indeed, after the programs had been instituted, many owners reported new customers and admitted that their establishments looked better. Sanitation methods were explained but more importantly, the underlying reasons were stressed. In a few instances, an inspector demonstrated the cleaning of certain equipment. In the cases where employees had been trained in sanitation methods (for instance in chain stores), the problem was the enforcement of sanitation by supervisory personnel.

Although approximately 65% of the businesses checked required complete sanitation programs; many minor but overlooked problems were encountered. An example of this was the disposal of meat-scraps. Meat-scraps were often disposed of in a container outside the door of the meat cutting area. Obviously, every time this door was opened, flies came in. A simple solution is to dispose of these scraps in a closed container at some distance from the door.

Of some importance is the fact that in establishments which cut their meat in the cooler, the bacteria count remained low. Since the equipment was also refrigerated, no sanitation problem was involved here. In fairness to the retail establishments, meat was checked from the local packing plant. This check was good.

In addition to the obvious rewards of new customers, personal pride, and a better looking establishment, the sanitation department established Sanitation Merit Awards which were given to businesses demonstrating a conscientious attitude for and a dutiful application of sanitation measures.

Occasionally some resistance was encountered, but in nearly every instance when the owner or operator undertood what we were trying to do, they cooperated fully. I believe that this shows what a concentrated sanitation program can accomplish.

OTTO W. RIEDEL
City Sanitarian
City Hall
Waterloo, Iowa

ACTH RAISES LEUKOCYTE COUNT IN COWS' MILK

Two Arizona dairy scientists, T. N. Wegner and G. H. Stott, found that intramuscular injection of ACTH raised the leukocyte count in the milk of a lactating dairy cow. The University of Arizona report is based on research with a group of high producing Holstein cows of all ages and at all stages of lactation.

The dairy animals were screened for normal milk leukocyte count (below 100,000/ml) and for absence of hemolytic bacteria in aseptically drawn milk samples. Each cow was given an intramuscular injection of 250 units of ACTH daily for 4 days. Blood samples and milk samples were taken just prior to injection. A total leukocyte count and a differential leukocyte count were performed on both blood and milk samples.

Results show that the leukocytosis and the ratio of lymphocytes to polymorphonuclear in blood following ACTH injection is paralleled by a proportionately greater rise in milk leukocytes and a similar shift in cell ratio of the differential leukocyte count in milk.

This would indicate that the increase in milk leukocytes resulted from an infiltration of leukocytes into the mammary gland from the blood in response to ACTH induced leukocytosis.

It was concluded that high leukocyte count milk can be caused by physiological stressing conditions without udder inflammation.

THE MEMPHIS ABNORMAL MILK PROGRAM

ROY R. PERKINS
Memphis and Shelby County
Health Department
Memphis, Tennessee 38105

The Memphis and Shelby County Health Department has undertaken the responsibility of eliminating abnormal milk from the Memphis Market. Contrary to the belief among some people that an abnormal milk program will not work, we believe that it must work in order to protect the consumers who would unknowingly drink the milk of diseased cows.

A program which protects consumers and increases the income of producers cannot and should not be ignored because of problems which some people in the milk industry and even a few individuals who enforce health and sanitation regulations use to explain the absence of programs in some areas. Some problems which these people mention are:

1. Screening tests not accurate;
2. Veterinarians won't cooperate;
3. Lack of qualified milking machine dealers;
4. Not enough fieldmen;
5. Will run producers out of business; and
6. Need more experimental work

These are problems, but certainly are not so serious that they cannot be overcome. Screening tests are indications of abnormality and are not meant to be an accurate determination of the amount of mastitis in a herd. There are many conditions which affect the leucocyte count of milk and thus show up on tests, but regardless of the cause of the high leucocyte count, the milk is abnormal and should not be sold for human consumption.

Veterinarians fail to properly treat infected herds in many cases because producers will not permit adequate treatment. Observation of the treatment of cows by veterinarians in the past eight years has shown than there is no "short cut" or "easy way" for treating cows which have mastitis. Infected cows must be removed from the milking herd, the milk discarded, and the cows treated with an anti-biotic which will kill the type of infection present. Vaccinations have not proven satisfactory for treating infected cows and in most cases, are a waste of the producer's money and the veterinarian's efforts.

It is difficult to find good milking machine dealers. Several factors contribute to this situation, and the most important is that of economics. Lack of dealers necessitates sanitarians and fieldmen becoming more familiar with installation and operation of milking machines. Before a pipeline milker may be installed in the Memphis Milkshed, a drawing and application for installation must be approved by the sanitarian. Industry fieldmen analyze existing installations when requested by sanitarians.

Industry fieldmen are an important part of any raw milk quality program, and cooperation between fieldmen and sanitarians is a must. Industry must be encouraged to provide service to their producers of raw milk. The Memphis Health Department programs are all built around this service.

Many producers of raw milk have gone out of business in the last few years all over the country regardless of whether abnormal milk programs were in force in their areas. Perhaps many of these producers would still be in business if they had been helped to control mastitis in their herds and keep their production up. The trend in the Memphis milkshed has been toward fewer producers, but the total production has gone up 8 to 10% per year.

It is very true that more experimental work needs to be done on screening tests, treatment of infected cows, and causes of infection. It has been the writers experience that most experimental work comes as a result of demand by industry for more knowledge. This demand will come after health agencies begin enforcing abnormal milk regulations and not before.

AN ENFORCEMENT PROGRAM ENTIRELY FEASIBLE

Many areas have abnormal milk enforcement programs similar to that recommended by the National Mastitis Council and are proving that an enforcement program will work. The Memphis and Shelby County program works because it is a realistic, effective program, has the backing of the milk industry, and is enforced by the Health Department.

Our Abnormal Milk Program dates back to 1960 when milk samples which showed a high bacteria count (standard plate count) were examined with the microscope by sanitarians for types of bacteria present and leucocyte count. A leucocyte count over 1,500,000 required the producer to have his cows checked and have a veterinarian treat the cows. A copy of the herd test and the veterinarian's report was sent to the Health Department as evidence of the producer's cooperation. This program was very effective for producers who were interested in hav-

ing clean herds. Other producers continued to ship abnormal milk while periodically having their cows checked and vaccinated in response to the Health Department's notices. By 1965, many producers had mastitis under control in their herds while others had made no progress at all. The program then in effect, became almost useless because about 10% of the producers were still shipping abnormal milk from old, low producing cows under poor milking conditions and the veterinarians were vaccinating cows which were already infected.

In 1966, Memphis sanitarians in the Milk Division placed primary emphasis on milking machines (especially vacuum systems). If there was an indication that a milking machine was not in good condition, the sanitarian notified the producer in writing that he must have his vacuum system examined and a report sent to the Health Department. When it showed that a milker needed repairs, the producer was checked as being in violation of Item 12 R (Construction) on the grade sheet. Fieldmen and dealers examined 145 machines and sanitarians were responsible for the installation of 66 new pumps and 103 new 1 1/4 inch vacuum lines.

Additional abnormal milk screening tests were begun in July, 1966. The Memphis branch of the Tennessee State Health Department Laboratory started making Wisconsin tests on all routine bacteriological samples. Dean Milk Company's Laboratory was approved to make monthly catalase tests on each of its producers. The Health Department Laboratory continued to test samples with the microscope. All official test results are sent to the Milk Division where they are converted to leucocyte counts. The producer is notified on each test. By January 1, 1967, at least six leucocyte counts were recorded on each producer.

MEMPHIS PROGRAM EFFECTIVE JANUARY 1, 1967

In 1966 a local mastitis committee composed of representatives of the Health Department, milk plants, and Milk Producers Association was formed. Through this committee, all segments of the milk industry were informed concerning the problem of abnormal milk, the degree of mastitis infection, and the complications of an enforcement program. Meetings were held with sanitarians, fieldmen and producers in an effort to better inform everyone about milking machines, screening tests, milking procedures, causes of mastitis, and treatment for mastitis. In October, 1966, the committee approved a program as outlined by the Health Department. This Program was put into effect January 1, 1967, and is substantially as follows:

Leucocyte Counts and Notifications—Whenever a producer has two Leucocyte counts that are 1,000,000 or more out of the last four, and the last count is 1,000,000 or more, he is sent a letter. This letter will require that the producer take action toward getting the abnormal milk out of his supply. A recommended procedure for the elimination of abnormal milk will be included with this letter.

Within ten (10) days after receipt of the first letter, the producer should check his cows for mastitis and send a report on each cow to the Milk Division office along with a statement as to the steps being taken to correct his abnormal milk problem. The statement may come from the producer or may come from his fieldman.

When the "report on the cows", the "statement on action being taken" and "another leucocyte test" is received in the Milk Division office, a decision will be made as to the status of the producer and he will be notified.

Suspensions—When a producer has not made satisfactory progress toward eliminating abnormal milk, he will be sent a warning letter. This warning letter will be followed by another leucocyte test. If this test results in a leucocyte count of 1,000,000 or more, the permit will be suspended.

A producer's permit will be suspended only as a last resort and only after he has received a warning from the Health Department. Suspension will be for at least two (2) days.

Reinstatement—Conditions for reinstatement of permit are as follows:

1. Make application for reinstatement with Health Department.
2. Receive leucocyte count below 1,000,000 (must be made in an approved laboratory).
3. Must prove to his sanitarian that he has removed all infected cows from the herd and will not sell their milk until they show negative on an abnormal milk screening test.
4. Re-inspection must be made by sanitarian.
5. Reinstatement of permit will be temporary, pending the receipt of two leucocyte counts below 1,000,000. A leucocyte count of 1,000,000 or more on either of the first two samples collected after reinstatement will result in another suspension.
6. The second suspension for abnormal milk in a current one year period will call for a suspension of at least ten (10) days and until all infected cows are removed from the premises.

The producer's status as a Grade A milk producer will depend upon his desire to produce good milk, and the technical assistance and guidance which he receives. Industry fieldmen and veterinarians will play an important part in this program.

CONCLUSION

This program has been extremely successful in eliminating much of the abnormal milk from the Memphis market. The best results were received after the first notice was sent. Many producers upon receiving this notice, removed the cows from their herds that were producing abnormal milk and changed their operations to keep their leucocyte counts below 1,000,000.

The number of high leucocyte counts has consistently gone down and the number of producers receiving high leucocyte counts has gone down since the program started. Most of the high counts now come from a few producers who have old, low producing cows. Of course, some of the better producers occasionally have flare-ups that are quickly controlled. The success of this program is largely due to the fact that a good program was put into action which had enforcement provisions, and the producers were informed of its conditions.

Unofficial tests and field kits used by unqualified technicians are a confusing detriment to a program. Cooperation between sanitarians, fieldmen, laboratory personnel, veterinarians, and producers will assure results from a program such as the one recommended by the National Mastitis Council.

The Memphis and Shelby County Health Department feels a strong responsibility to the consumers of milk to eliminate abnormal milk from the supply, and believes that the Departments of Agriculture and the milk industry has a responsibility to the producer to help him eliminate mastitis from his herd because a more profitable operation would result.

WASTE DISPOSAL COSTS

Dairymen seeking to scale down waste disposal costs have some research-based figures on alternate cleaning methods to consider.

A Washington State University dairy scientist, Dr. M. H. Ehlers, Pullman, reported that scrape-and-haul cleaning can meet sanitary needs at less cost than flushing the waste down the drain with high-pressure hoses.

The comparative annual costs: $601 for scrape and haul, and $1,044 for high-pressure hosing.

Dr. Ehler's conclusion is based on a recent WSU study of cleaning costs for an exterior concrete-surfaced feeding and exercise area used by a 100-cow dairy herd. The cleaning problem involved disposal of a daily accumulation of a ton and a half of waste.

He said the trend toward confined handling of dairy cattle has accentuated the problem of waste disposal. Dairymen are seeking information on cleaning methods and costs and on disposal systems that will not create a public nuisance.

In the WSU study waste from half the lot was scooped up and hauled away twice a week. Waste on the other half of the lot was hosed daily into drains leading to a system of lagoons. The amount of waste to be handled made daily hosing essential even though a pressure hose was used.

A tractor-mounted hydraulic scoop was used for the twice-weekly cleaning. The cleaning method met sanitary needs, but the lot was less presentable than the one hosed down every day.

Labor was the major cost item for both cleaning methods. The scrape-and-haul method required 1 hr and 40 min per week. Daily hosing required 4 hr and 40 min per week.

Cost of both methods was lower during the winter quarter. Freezing weather sometimes made cleaning impossible, and, also, less urgent.

Ehlers added that work is continuing at Washington State University on mechanical devices to reduce the labor cost involved in hosing down exterior concrete lots.

HOLDERS OF 3-A SYMBOL COUNCIL AUTHORIZATIONS ON AUGUST 20, 1968

"Questions or statements concerning any of the holders of authorizations listed below, or the equipment fabricated, should be addressed to C. A. Abele, Secretary-Treasurer, 2617 Hartzell St., Evanston, Ill. 60201."

0101 Storage Tanks for Milk and Milk Products, as Amended

97 Beseler Steel Products, Inc. (3/24/58)
417 East 29th, Marshfield, Wisconsin 54449

116 Jacob Brenner Company, Inc. (10/ 8/59)
450 Arlington, Fond du Lac, Wisconsin 54935

28 Cherry-Burrell Corporation (10/ 3/56)
2400 Sixth Street, S.W., Cedar Rapids, Iowa 52404

102 Chester-Jensen Company, Inc. (6/ 6/58)
5th & Tilgham Streets, Chester, Pennsylvania 19013

1 Chicago Stainless Equipment Corp. (5/ 1/56)
5001 No. Elston Avenue, Chicago, Illinois 60630

2 CP Division, St. Regis (5/ 1/56)
1243 W. Washington Blvd., Chicago, Illinois 60607

117 Dairy Craft, Inc. (10/28/59)
Holdingford, Minnesota 56340

76 Damrow Brothers Company (10/31/57)
196 Western Avenue, Fond du Lac, Wisconsin 54935

115 DeLaval Company, Ltd. (9/28/59)
113 Park Street, So., Peterborough, Ont., Canada

109 Girton Manufacturing Company (9/30/58)
Millville, Pennsylvania 17846

21 The J. A. Gosselin Co., Ltd. (9/20/56)
P. O. Box 280, Drummondville, Quebec, Canada

44 The Heil Company (10/26/56)
3000 W. Montana Street, Milwaukee, Wisconsin 53235

114 C. E. Howard Corporation (9/21/59)
9001 Rayo Avenue, South Gate, California 90280

127 Paul Mueller Company (6/29/60)
1616 W. Phelps Street, Springfield, Missouri 65801

197 Mueller/Richardson Ltd. (9/ 9/67)
84 Wellington St., South, St. Marys, Ont.

143 Portersville Stainless Equipment Div., (5/16/63)
Gibson Industries, Inc.
Portersville (Butler County), Pennsylvania 16051

31 Walker Stainless Equipment Co. (10/ 4/56)
Elroy, Wisconsin 53929

0201 Pumps for Milk and Milk Products, Revised, as Amended

29R Cherry-Burrell Corporation (10/ 3/56)
2400 Sixth Street, S.W., Cedar Rapids, Iowa 52404

63R CP Division, St. Regis (4/29/57)
1243 W. Washington Blvd., Chicago, Illinois 60607

180R The DeLaval Separater Co. (5/ 5/65)
Poughkeepsie, N. Y. 12602

65R G & H Products Corporation (5/22/57)
5718 52nd Street, Kenosha, Wisconsin 53140

145R ITT Jabsco, Incorporated (11/20/63)
1485 Dale Way, Costa Mesa, Calif. 92626

26R Ladish Co., Tri-Clover Division (9/29/56)
2809 60th Street, Kenosha, Wisconsin 53140

148R Robbins & Myers, Inc. (4/22/64)
Moyno Pump Division
1895 Jefferson Street, Springfield, Missouri 65803

163R Sta-Rite Products, Inc. (5/ 5/65)
234 South 8th Street, Delavan, Wisconsin 53115

72R L. C. Thomsen & Sons, Inc. (8/15/57)
1303 53rd Street, Kenosha, Wisconsin 53140

175R Universal Milking Machine Div., (10/26/65)
National Cooperatives, Inc.
First Avenue at College, Albert Lea, Minn. 56007

52R Viking Pump Company (12/31/56)
406 State Street, Cedar Falls, Iowa 50613

5R Waukesha Foundry Company (7/ 6/56)
Waukesha, Wisconsin 53186

0400 Homogenizers and High Pressure Pumps of the Plunger Type, As Amended

87 Cherry-Burrell Corporation (12/20/57)
2400 Sixth Street, S. W., Cedar Rapids, Iowa 52404

37 CP Division, St. Regis (10/19/56)
1243 W. Washington Blvd., Chicago, Illinois 60607

75 Manton-Gaulin Mfg. Co., Inc. (9/26/57)
44 Garden Street, Everett, Massachusetts 02149

0501 Stainless Steel Automotive Milk Transportation Tanks for Bulk Delivery and/or Farm Pick-up Service, As Amended

131 Almont Welding Works, Inc. (9/ 3/60)
4091 Van Dyke Road, Almont, Michigan 48003

98 Beseler Steel Products, Inc. (3/24/58)
417 East 29th, Marshfield, Wisconsin 54449

70 Jacob Brenner Company (8/ 5/57)
450 Arlington, Fond du Lac, Wisconsin 54935

40 Butler Manufacturing Co. (10/20/56)
1600 Berry Avenue, St. Paul, Minnesota 55114

118 Dairy Craft, Inc. (10/28/59)
Holdingford, Minnesota 56340

66 Dairy Equipment Company (5/29/57)
1919 So. Stoughton Road, Madison, Wisconsin 53716

123 DeLaval Company, Ltd. (12/31/59)
113 Park Street, South, Peterborough, Ont., Canada

190 Eastern Industries, Limited (11/18/66)
830 Blvd., Lemire, Drummondville, Quebec, Canada

121 The J. A. Gosselin Co., Ltd. (12/ 9/59)
P. O. Box 280, Drummondville, Quebec, Canada

45 The Heil Company (10/26/56)
3000 W. Montana Street, Milwaukee, Wisconsin 53235

201 Paul Krohnert Mfg., Ltd. (4/ 1/68)
West Hill, Ontario, Canada

80 Mueller/Richardson, Ltd. (11/24/57)
84 Wellington Street, So., St. Marys, Ont., Canada

93 Pennsylvania Furnace & Iron Co. (2/ 6/58)
316 Pine Street, Warren, Pennsylvania 16365

85 Polar Manufacturing Company (12/20/57)
Holdingford, Minnesota 56340

144 Portersville Stainless Equipment Div., (5/16/63)
Gibson Industries, Inc.
Portersville (Butler County), Pennslyvania 16051

71 Progress Industries, Inc. (8/ 8/57)
400 E. Progress Street, Arthur, Illinois 61911

47 Trailmobile Div. of Pullman, Inc. (11/ 2/56)
16th & Howell Streets, North Kansas City, Mo. 64116

189 A. & L. Tougas, Ltée (10/ 3/66)
1 Tougas St., Iberville, Quebec, Canada

25 Walker Stainless Equipment Co. (9/28/56)
New Lisbon, Wisconsin 53950

0800 Fittings Used on Milk and Milk Products Equipment, and Used on Sanitary Lines Conducting Milk and Milk Products and Supplements 2, 3, 4, 5, and 6 As Amended

79 Alloy Products Corporation (11/23/57)
1045 Perkins Avenue, Waukesha, Wisconsin 53186

138 A.P.V. (Canada) Equipment, Ltd. (12/17/62)
103 Rivalda Rd., Weston, Ont., Canada

82 Cherry-Burrell Corporation (12/11/57)
2400 Sixth Street, S.W., Cedar Rapids, Iowa 52404

124 DeLaval Company, Ltd. (2/18/60)
113 Park Street, South, Peterborough, Ont., Canada

184 The DeLaval Separator Co. (8/ 9/66)
Poughkeepsie, New York 12602

67 G & H Products Corporation (6/10/57)
5718 52nd Street, Kenosha, Wisconsin 53140

199 Gray Company, Inc. (12/ 8/67)
60 Eleventh Ave., N.E., Minneapolis, Minn. 55413

89 Burton Klemp Corporation (3/24/60)
6613 28th Avenue, Kenosha, Wisconsin 53140

34 Ladish Co., Tri-Clover Division (10/15/56)
2809 60th St., Kenosha, Wisconsin 53140

200 Paul Mueller Co. (3/ 5/68)
1616 Phelps St., Springfield, Mo. 65601

149 Q Controls (5/18/64)
Occidental, California 95465

73 L. C. Thomsen & Sons, Inc. (8/31/57)
1303 43rd Street, Kenosha, Wisconsin 53140

191 Tri-Canada Fittings & Equipment Ltd. (11/23/66)
21 Newbridge Road, Toronto 18, Ontario

151 Tubular Components, Inc. (11/18/64)
Butternut Drive, East Syracuse, New York 13057

86 Waukesha Specialty Company (12/20/57)
Walworth, Wisconsin 53184

0900 Thermometer Fittings and Connections Used on Milk and Milk Products Equipment and Supplement 1, As Amended

32 Taylor Instrument Companies (10/ 4/56)
95 Ames Street, Rochester, New York 14611

1000 Milk and Milk Products Filters Using Disposable Filter Media, As Amended

35 Ladish Co., Tri-Clover Division (10/15/56)
2809 60th Street, Kenosha, Wisconsin 53140

1100 Plate-Type Heat Exchangers for Milk and Milk Products, As Amended

20 A.P.V. Company, Inc. (9/ 4/56)
137 Arthur Street, Buffalo, New York 14207

30 Cherry-Burrell Corporation (10/ 1/56)
2400 Sixth Street, S.W., Cedar Rapids, Iowa 52404

14 Chester-Jensen Co., Inc. (8/15/56)
5th & Tilgham Streets, Chester, Pennsylvania 19013

38 CP Division, St. Regis (10/19/56)
1243 W. Washington Blvd., Chicago, Illinois 60607

120 DeLaval Company, Ltd. (12/ 3/59)
113 Park Street, South, Peterborough, Ont., Can.

17 The DeLaval Separator Company (8/30/56)
Poughkeepsie, New York 12602

15 Kusel Dairy Equipment Company (8/15/56)
100 W. Milwaukee Street, Watertown, Wisconsin 53094

1200 Internal Return Tubular Heat Exchangers, for Milk and Milk Products, As Amended

103 Chester-Jensen Company, Inc. (6/ 6/58)
5th & Tilgham Street, Chester, Pennsylvania 19013

96 C. E. Rogers Company (3/31/64)
8731 Witt Street, Detroit, Michigan 48209

152 Sanitary Processing Equipment Corp. (11/18/64)
Butternut Drive, East Syracuse, New York 13057

1301 Farm Milk Cooling and Holding Tanks — Revised, As Amended

11R CP Division, St. Regis (7/25/56)
1243 W. Washington Street, Chicago, Illinois 60607

119R Dairy Craft, Inc. (10/28/59)
Holdingford, Minnesota 56340

4R Dairy Equipment Company (6/15/56)
1919 S. Stoughton Road, Madison, Wisconsin 53716

92R DeLaval Company, Ltd. (12/27/57)
113 Park Street, South
Peterborough, Ontario, Canada

49R The DeLaval Separator Company (12/ 5/56)
Poughkeepsie, New York 12602

94R Esco Cabinet Company (2/ 6/58)
West Chester, Pennsylvania 19380

10R Girton Manufacturing Company (7/25/56)
Millville, Pennsylvania 17846

95R Globe Fabricators, Inc. (3/14/58)
7744 Madison Street, Paramont, California 90723

179R Heavy Duty Products (Preston), Ltd. (3/ 8/66)
635 Laurel St., Preston, Ont., Canada

12R Paul Mueller Company (7/31/56)
1616 W. Phelps Street, Springfield, Missouri 65801

58R Schweitzer's Metal Fabricators, Inc. (2/25/57)
806 No. Todd Avenue, Azusa, California 91702

50R Emil Steinhorst & Sons, Inc. (12/20/56)
612-616 South Street, Utica, New York 13503

134R Universal Milking Machine Division (5/19/61)
National Co-operatives, Inc.
First Avenue at College, Albert Lea, Minn. 56007

182R Vacooler Co. (5/20/66)
700 Gaylord Ave., Elyria, Ohio 44035

42R VanVetter, Inc. (10/22/56)
2130 Harbor Avenue S.W., Seattle, Washington 98126

18R Whirlpool Corporation, St. Paul Division (9/20/56)
850 Arcade Street, St. Paul, Minnesota 55106

55R John Wood Company (1/23/57)
Superior Metalware Division
509 Front Avenue, St. Paul, Minnesota 55117

170R The W. C. Wood Co., Ltd. (8/ 9/65)
5 Arthur Street, South, Guelph, Ont., Canada

16R Zero Manufacturing Company (8/27/56)
Washington, Missouri 63090

1400 Inlet and Outlet Leak Protector Plug Valves for Batch Pasteurizers

122 Cherry-Burrell Corporation (12/11/59)
2400 Sixth Street, S.W., Cedar Rapids, Iowa 52404

69 G & H Products Corporation (6/10/57)
5718 52nd Street, Kenosha, Wisconsin 53140

27 Ladish Co. - Tri-Clover Division (9/29/56)
2809 60th Street, Kenosha, Wisconsin 53140

78 L. C. Thomson & Sons, Inc. (11/20/57)
1303 43rd Street, Kenosha, Wisconsin 53140

1600 Evaporators and Vacuum Pans for Milk and Milk Products, As Amended

132 A.P.V. Company, Inc. (10/26/60)
137 Arthur Street, Buffalo, New York 14207

111 Blaw-Knox Company, (2/12/59)
Dairy Equipment Division
750 E. Perry, Buffalo, N. Y. 14210

110 Arthur Harris & Company (11/10/58)
210-218 North Aberdeen Street, Chicago, Illinois 60607

128 Mojonnier Bros. Co. (7/ 6/60)
4601 W. Ohio Street, Chicago, Illinois 60644

164 Mora Industries, Inc. (4/25/65)
112 South Park Street, Mora, Minnesota 55051

107 C. E. Rogers Company (8/ 1/58)
8731 Witt Street, Detroit, Michigan 48209

186 Marriott Walker Corporation (9/ 6/66)
925 East Maple Road, Birmingham, Mich. 48008

1700 Fillers and Sealers of Single Service Containers, For Milk and Milk Products, As Amended

192 Cherry-Burrell Corporation (1/ 3/67)
2400 Sixth St., S.W., Cedar Rapids, Iowa 52404

139 Exact Weight Scale Company (4/15/68)
538 East Town Street, Columbus, Ohio 43215

137 Ex-Cell-O Corporation (10/17/62)
P. O. Box 386, Detroit, Michigan 48232

140 General Films, Inc. (4/23/63)
Covington, Ohio 55318

142 Polygal Company (4/15/63)
Div. of Inland Container Corp.
P. O. Box 68074, Indianapolis, Indiana 46268

1900 Batch and Continuous Freezers, For Ice Cream, Ices and Similarly Frozen Dairy Foods, As Amended

141 CP Division, St. Regis (4/15/63)
1243 W. Washington Blvd., Chicago, Illinois 60607

146 Cherry-Burrell Corporation (12/10/63)
2400 Sixth Street, S.W., Cedar Rapids, Iowa 52404

2300 Silo-Type Storage Tanks for Milk and Milk Products

168 Cherry-Burrell Corporation (6/16/65)
2400 Sixth Street, S. W., Cedar Rapids, Iowa 52404

154 CP Division, St. Regis (2/10/65)
1243 W. Washington Blvd., Chicago, Illinois 60607

160 Dairy Craft, Inc. (4/ 5/65)
Holdingford, Minnesota

181 Damrow Brothers Company (5/18/66)
196 Western Ave., Fond du Lac, Wisconsin 54935

156 C. E. Howard Corporation (3/ 9/65)
9001 Rayo Avenue, South Gate, California 90280

155 Paul Mueller Co. (2/10/65)
1616 W. Phelps Street, Springfield, Missouri 65801

195 Mueller/Richardson, Ltd. (7/ 6/67)
84 Wellington St., So., St. Marys, Ont. Canada

165 Walker Stainless Equipment Co. (4/26/65)
New Lisbon, Wisconsin 53950

2300 Equipment for Packaging Frozen Desserts, Cottage Cheese and Milk Products Similar to Cottage Cheese in Single Service Containers

174 Anderson Bros. Mfg. Co. (9/28/65)
1303 Samuelson Road, Rockford, Illinois 61109

178 John A. Carrier Corporation (2/18/66)
Middlesex Turnpike, Burlington, Mass. 01804

193 Triangle Package Machinery Co. (1/31/67)
6655 West Diversey Ave., Chicago, Illinois 60635

2400 Non-Coil Type Batch Pasteurizers

161 Cherry-Burrell Corporation (4/ 5/65)
2400 Sixth Street, S.W., Cedar Rapids, Iowa 52404

158 CP Division, St. Regis (3/24/65)
1243 W. Washington Blvd., Chicago, Illinois 60607

187 Dairy Craft, Inc. (9/26/66)
Holdingford, Minnesota 56340

177 Girton Manufacturing Co. (2/18/66)
Millville, Pennsylvania 17846

166 Paul Mueller Co. (4/26/65)
1616 W. Phelps Street, Springfield, Missouri 65802

198 Mueller/Richardson, Ltd. (9/ 9/67)
84 Wellington St., South, St. Marys, Ont.

2500 Non-Coil Type Batch Processors for Milk and Milk Products

162 Cherry-Burrell Corporation (4/ 5/65)
2400 Sixth Street, S.W., Cedar Rapids, Iowa 52404

159 CP Division, St. Regis (3/24/65)
1243 W. Washington Blvd., Chicago, Illinois 60607

188 Dairy Craft, Inc. (9/26/66)
Holdingford, Minnesota 56340

167 Paul Mueller Co. (4/26/65)
1616 W. Phelps Street, Springfield, Missouri 64801

196 Mueller/Richardson, Ltd. (7/ 6/67)
84 Wellington St., So., St. Marys, Ont., Canada

2600 Sifters for Dry Milk and Dry Milk Products

171 Entoleter, Inc. (9/ 1/65)
Subsidiary of American Mfg. Co.
1187 Dixwell Avenue, Hamden, Connecticut 06514

173 Food & Chemical Equipment Div., (9/20/65)
Blaw-Knox Company
1325 S. Cicero Avenue, Chicago, Illinois 60650

185 The Orville-Simpson Co. (8/10/66)
1230 Knowlton St., Cincinnati, Ohio 45223

172 Southwestern Engineering Co. (9/ 1/65)
6111 E. Bandini Blvd., Los Angeles, California 90022

176 Sprout, Waldron & Co., Inc. (1/ 4/66)
Munsy, Pennsylvania 17756

FACTORS AFFECTING THE WISCONSIN MASTITIS TEST[1]

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Abstract

The influence of chemical sanitizers, lysozyme, DNAase, storage time and temperature, hydrolytic rancidity, and heat treatment on the Wisconsin Mastitis Test (WMT) was studied.

Concentrations of 25 to 50 ppm of iodophor and quaternary ammonium compound sanitizers caused significant reductions in WMT values. The test was not affected by chlorine, chloramine-T, or an acid sanitizer. The WMT reaction was completely destroyed by 12.5 μg or more of DNAase/9 ml of milk.

Significant decreases in WMT values occurred after storage for longer than 24 hr and the rate of decline increased when storage temperatures above 4.5 C were used. Lysozyme concentrations of 50 to 200 μg/100 ml of milk decreased the rate at which the WMT values declined during storage. The test values were not affected by increases in acid degree values.

Heat treatments greater than 43 C for 1 min caused severe reductions in WMT values. The effect increased as the severity of the heat treatment was increased.

The Wisconsin Mastitis Test (WMT) has been recommended by the U. S. Public Health Service as a screening test for abnormal milk *(9)*. The relationship of WMT values and leucocyte numbers has been established *(8)*. Other factors that have been studied include the reproducibility of the test and the effect of storage time on the reaction.

There is a lack of information concerning factors that might affect the reliability of the WMT. The purpose of this study was to obtain information on factors that might adversely affect the reliability of the test.

Experimental Procedures

Collection and testing of samples. Milk samples were obtained from the University of Kentucky dairy herd. Samples were cooled and stored at 4.5 C when not used immediately after collection. The WMT was performed as outlined by Thompson and Postle *(8)*. Samples with WMT values within the range of 10-30 were used in these experiments.

Chemical sanitizers. Concentrated solutions of commercial sanitizers were prepared so that a constant volume of solution could be added to test samples to give concentrations of 0-50 ppm in the milk samples. An equal volume of distilled water was added to the control sample (0 ppm). WMT values were determined immediately after the addition of the sanitizers and after holding for 5, 24, and 48 hr.

Lysozyme. Concentrations of commercial lysozyme (Nutritional Biochemical Corporation, 3 X crystallized) ranged from 0-200 μg/100 ml of enzyme-milk mixture. The method of adding the lysozyme was the same as used for chemical sanitizers.

DNAase. Commercial DNAase (Nutritional Biochemical Corporation) was made up to a concentration of 50 mg/100 ml in 0.25% gelatin. Each ml of solution contained 35,000 dornase units. Concentrations of the enzyme in milk ranged from 0-400 μg of enzyme/9 ml of sample. The final volume of enzyme-milk mixture was adjusted to 10 ml with 0.25% gelatin.

Acid degree value. The test samples were divided into four parts. Each of three parts was agitated in a Waring blender to induce rancidity *(1)*. The control was not agitated. WMT values and acid degree values (ADV) were determined immediately after agitation and after storage for 24, 48, and 72 hr at 4.5 C. The acid degree values were determined using the Minnesota modified method *(7)*.

Storage temperature and time. The test samples were separated into eight portions. Half of these were tested and cooled immediately to storage temperatures of 2-10 C. The four remaining portions were allowed to remain at room temperature for 2 hr before being tested and cooled. The samples were held for 4, 24, 48 and 72 hr from the time each sample was cooled to the appropriate temperature. Additional WMT values were obtained at the completion of each storage time and temperature.

Heat treatment. WMT values were determined on each sample immediately after collection and were used as the control values. Portions of each sample, 10 ml in size, were placed in 16 x 125 mm screwtop culture tubes. These portions were simultaneously placed in a water bath of the temperature being investigated. The temperatures investigated ranged from 38-54 C. Approximately 4 min were required for the samples to reach the desired temperature. This time is not included in the holding time. Each portion was placed in ice water for 10 min after it was removed from the heating bath and then tested.

Results and Discussion

Chemical sanitizers. This investigation was made on two iodophors, two chlorines, two quaternary ammonium compounds (QAC), and an acid sanitizer. Active ingredients for the iodophors were: phosphoric acid, nonyl phenoxy polyethoxy ethanol-iodine complex; and polyethoxy polypropoxy ethanol-iodine complex, nonyl phenylether of polyethylene glycol-iodine complex. The chloramine-T was a potassium iodide complex. Chlorine compounds investigated were sodium hypochlorite and dichloroisocyanuric

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TABLE 1. EFFECT OF CHEMICAL SANITIZERS ON THE WISCONSIN MASTITIS TEST VALUES[a]

Time tested[b]	Parts per million of sanitizer				
	0	5	10	25	50
	WMT values				
Iodophor[c]					
0 hr.	20.1	19.3	18.2	15.2**	10.4**
5 hr.	16.7	15.5	15.2	13.7**	11.4**
24 hr.	15.3	14.8	14.9	10.4**	6.0**
48 hr.	11.9	11.5	10.3	7.1**	3.3**
Iodophor[d]					
0 hr.	19.7	19.3	17.9	16.5**	15.2**
5 hr.	19.6	19.7	19.2	15.9**	10.2**
24 hr.	16.0	16.7	15.7	11.4**	7.6**
48 hr.	11.8	12.5	11.5	7.7**	3.2**
QAC[e]					
0 hr.	19.6	19.8	19.7	19.5	18.9
5 hr.	18.7	19.2	18.3	17.7**	17.8**
24 hr.	16.7	15.5	15.3**	14.8**	14.2**
48 hr.	13.2	13.0	12.6	12.4	11.5**
QAC[f]					
0 hr.	23.2	23.1	23.0	22.8	22.6**
5 hr.	21.3	2.1	20.6	20.5	18.7**
24 hr.	19.1	18.8	19.1	17.2	13.0**
48 hr.	14.4	14.7	14.2	21.1*	9.3**

*Significant at 5% level.
**Significant at 1% level.
[a]Results with each sanitizer represent trials with 5 different samples of milk.
[b]Storage at 4.5 C after the addition of the sanitizer.
[c]Phosphoric acid, nonyl phenoxy polyethoxy ethanol—iodine complex, polyethoxy polypropxy polyethoxy ethanol—iodine complex.
[d]Polyethoxy polypropoxy ethanol—iodine complex, nonyl phenylether of polyethylene glycol—iodine complex.
[e]Alkyl dimethyl benzyl ammonium chloride.
[f]Alkyl dimethyl benzyl ammonium chloride, dimethyl ethylbenzyl ammonium chloride.

acid. Active ingredients of the QACs were alkyl dimethyl benzyl ammonium chloride; and alkyl dimethyl benzyl ammonium chloride, dimethyl ethybenzyl ammonium chloride. Orthophosphoric acid and dodecyl benzene sulfonic acid were the active ingredients in the acid sanitizer.

Concentrations of the sanitizers investigated were 0 (control), 5, 10, 25, and 50 ppm in the milk. The WMT values were not significantly affected by the chlorines, Chloramine T, nor the acid sanitizer.

The results obtained with the iodophors and quaternary ammonium compounds are shown in Table 1. At concentrations of 25 and 50 ppm both of the iodophors caused reductions in the WMT values that were significantly ($P<.01$) lower than the test values for the control samples. These reductions were apparent at the completion of every holding period. When tested immediately after the addition of the sanitizer to the milk, neither QAC caused significant reductions in the WMT values. However, both QACs at concentrations of 50 ppm caused significantly ($P<.01$) lower readings than did the control sample at the completion of each holding period. The QAC which contained only one active ingredient had a greater effect on the WMT values than the QAC which contained two active ingredients.

The results of this experiment indicate that the active ingredients of the sanitizers were not responsible for the effect on the WMT. If iodine was responsible for the reduction in the WMT values, the chloramine-T potassium iodide sanitizer investigated should have had an effect on the test. Both QAC sanitizers contained alkyl dimethyl benzyl ammonium chloride. In addition, one QAC contained alkyl dimethyl ethybenzyl ammonium chloride. It is probable that the organic carriers of the active ingredients or the wetting agents contained in the sanitizers were responsible for the reductions in the WMT values.

Lysozyme. Lysozyme was added to milk in concentrations of 12.5, 25, 50, 100, and 200 μg/99 ml of sample. Results presented in Table 2 show that none of the concentrations of lysozyme investigated had an effect on the WMT when the samples were tested immediately and after storage for 4 hr at 4.5 C. Samples with concentrations of 50, 100, and 200 μg of lysozyme had higher WMT values than the control samples after storage for 24 and 48 hr. Singh and Marshall *(6)* have suggested that once DNA is released into the milk it loses its reactivity or becomes non-reactive. Lysozyme could conceivably inhibit factors that might cause the deterioration of the leucocytes and prevent the release of DNA into the milk.

DNAase. DNAase was added to the milk samples in amounts ranging from 0-28,000 (0-400 μg DNAase) dornase units /9 ml of sample. The reaction of the WMT was completely destroyed by all concentrations (12.5 to 400 μg) of DNAase investigated. This

TABLE 2. EFFECT OF LYSOZYME ON WISCONSIN MASTITIS TEST VALUES[a]

Time tested[b]	Micrograms of lysozyme/99 ml of sample					
	0	12.5	25	50	100	200
	WMT values					
0 hr	25.2	25.0	25.2	25.0	25.3	25.3
4 hr	24.8	24.8	24.7	25.2	25.1	25.2
24 hr	21.7	21.6	21.6	22.4*	23.1**	23.3**
48 hr	19.3	19.3	19.5	20.5**	21.0**	21.1**

[a]Each WMT Value represents the average of 5 samples.
[b]Storage at 4.5 C after addition of lysozyme.
*Statistically significant at 5% level.
**Statistically significant at 1% level.

TABLE 3. EFFECT OF STORAGE TIME AND TEMPERATURE ON WISCONSIN MASTITIS TEST VALUES[a]

Time tested (hr)	Storage temperature (°C) 2	4.5	7	10
	WMT values			
0 (Control)	24.6	24.6	24.5	24.5
4	24.5	24.5	24.6	24.5
24	24.5	24.6	24.7	24.5
48	20.4**	20.1**	20.1**	17.7**
72	17.6[b]**	17.3[b,c]**	16.4[c]**	15.1[d]**

[a]Each WMT Value is the average of 5 samples of milk. Samples cooled immediately to the temperature investigated.
[bcd]Means on the same line with different superscripts are significantly different ($P<.05$).
**Statistically lower ($P<.01$) than control WMT Value.

TABLE 4. EFFECT OF HEAT TREATMENT ON THE WISCONSIN MASTITIS TEST VALUES[a]

Holding time (Min)	Temperature °C 38	43	49	54
	WMT values			
0 (Control)	20.3	24.3	21.2	26.0
1	19.9	18.5*	8.9**	9.3**
2	19.5	17.9**	9.4**	7.2**
4	19.8	17.5**	9.3**	5.8**
6	20.4	17.5**	8.9**	5.7**
8	20.1	17.8**	9.3**	4.9**
10	19.7	16.1**	5.4**	3.5**
15	19.0	15.1**	5.2**	3.2**
20	18.9	14.7**	4.4**	3.9**

*Significant at 5% level.
**Significant at 1% level.
[a]Average of 5 different samples.

is in agreement with the results concerning the effect of DNAase on the California Mastitis Test and the Modified Whiteside Test previously reported by other investigators *(2, 5)*.

Acid degree values. Rancidity was induced in the samples as described in the experimental methods. WMT and ADV values were determined after 0, 24, 48, and 72 hr of storage at 4.5 C. Although high acid degree values resulted in more variation of the WMT values, the WMT values of the rancid milk were not statistically lower than those for the control samples.

Storage time and temperature. Samples were stored at 2, 4.5, 7 and 10 C. No statistically significant reductions were observed in the WMT values after storage for 24 hr (Table 3). However, after storage for 48 hr the WMT values for the samples at all storage temperatures were significantly ($P<.01$) lower than the WMT values of the control samples. The decline observed in the WMT values with increasing storage time is in close agreement with the results published by Kroger and Jasper *(3)*.

There was no statistically significant difference in the effects of storage temperatures of 2, 4.5, 7, and 10 C during the first 48 hr of storage. However, the samples stored at 10 C for 72 hr had WMT values that were significantly ($P<.05$) lower than the WMT values of the samples stored for this period at the other storage temperatures. Samples stored at 7 C had WMT values lower ($P<.05$) than the samples stored at 2 C for 72 hr. The effect of delayed cooling was examined as described in the experimental methods. WMT values for samples that were allowed to remain at room temperature for 2 hr before cooling did not decrease faster than the WMT values for samples cooled immediately.

These results suggest that WMT values should be obtained on samples of milk within 24 hr if they are to be reliable. Although the influence of different storage temperatures on the WMT values was apparent, this effect was not evident until the samples had been stored for longer than 24 hr.

Heat treatment. Samples of milk were exposed to temperatures of 38, 43, 49, and 54 C for 0 (control) 1, 2, 4, 6, 8, 10, 15, and 20 min. The effects of these heat treatments on the WMT values are shown in Table 4. Heating at 38 C did not affect the WMT values at any of the holding times investigated. However, exposure of the samples at 43 C for 1 min caused reductions in the WMT that were statistically significant ($P<.05$). Heat treatments greater than this caused drastic reductions in the WMT values that were statistically significant at the 1% level. It seem improbable that protein would be denatured to a significant extent at the heat treatments investigated. However, the heat could possibly affect the ability of the DNA to form a gel with the reagent. Further studies are needed in this area.

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ASSOCIATION AFFAIRS

REPORT OF AD HOC COMMITTEE ACTIVITIES RELATING TO MERGER OF IAMFES-NAS

W. C. LAWTON, *Chairman*

55th Annual Meeting, St. Louis, Missouri
August 18-22, 1968

I speak to you this morning with some degree of regret—regret because I must report failure by the Ad Hoc Committee you entrusted with an important assignment—regret because I cannot bring to you for approval a document creating a new organization that is the culmination of two years work by many dedicated sanitarians—a document in which I believe the Committee of the two organizations created a new and dynamic concept based on the best features of the two parent organizations.

However, while I have regrets, I do not subscribe to the belief that time has been wasted, or that future effort is futile. I have a strong and vital belief in the innate sensibilities of the rank and file sanitarian, of which I am proud to be a member.

I would like to spend the time allotted to me to review with you in summary, the thinking and work leading up to the seventh draft of the by-laws proposal, the salient points of this draft, and some conjecture on its demise.

Not quite two years ago an Ad Hoc Committee of your association under the capable chairmanship of Dr. Paul Elliker, and one from NAS chaired by Dr. Wm. G. Walter, met in Kansas City to make a further attempt at a so-called merger of the two organizations. From this meeting emerged the basic philosophy that was to guide our two committees for two years, build a *new* organization based on what was the best of the two existing organizations. We attempted to put aside all thought of what was best for IAMFES or what was best for NAS, because if we were to be successful, these organizations would not exist, and we wanted all members to look with pride on their new organization, not with regret for the old.

Our President put it well in his Presidential Address yesterday—"Do not think about 'we' and 'they', but about 'us'." The culmination of this first meeting was a thorough understanding by both committees of our objectives, and a crude first draft of a set of by-laws. Numerous meetings, mountains of correspondence, revisions, etc., followed.

I must pause here to pay tribute to one man who more than any other, contributed of his time, efforts, and talent, in this monumental effort—Dr. Wm. G. Walter, Chairman of the NAS Committee. Without his constant effort at coordination, reprinting of drafts, etc., this result could never have been achieved.

A report of the third draft was made at the NAS meeting last year, and at the International meeting in Miami. From both meetings came ideas and suggestions, resulting in revisions and correspondence, to create three more drafts.

The seventh and final draft resulted from a joint meeting of our two committees in Denver last April. This draft corrected the majority of the objections raised at the meeting in Miami. I would like to briefly outline a few of the important points of the by-laws of the proposed new organization—

1. Four names were proposed, and would be voted on by the membership after the merger was completed.
2. Membership would be divided into—
   a. A member is one having a bachelor's degree or seven years as a full time sanitarian, or in the area of education or public health activity. A member can vote and hold office. All existing members of IAMFES were to be blanketed in in this category.
   b. Associate Member—Those actively working but for too short a time and those not having a degree. They could vote but not hold office.
   c. A Fellow would be conferred by the Awards Committee—could vote and hold office.
   d. Sustaining Member—An individual or a corporation with an interest in the profession, but with no experience or activity. No voting privileges and could not hold office.
   d. Sustaining Member—An individual or a corporation with an interest in the profession, but with no experience or activity. No voting privileges and could not hold office.
   e. Student Member.
   f. Life Member
   g. Honorary Member
3. There would be two official publications—the mechanics of these publications to be worked out by the new administration.
4. The officers would include—
   a. Immediate Past President
   b. President

c. President Elect
d. 1st Vice President
e. 2nd Vice President
f. Secretary
g. Treasurer—to be appointed by the Executive Board.

5. The Association would be divided into five sections
   a. Milk and food
   b. General environmental
   c. Water and air polution
   d. Housing and urban development
   e. Health facilities

Each section would have a chairman, vice chairman, secretary, with provisions for other sections as the need arises.

6. The Executive Board would consist of the officers (except the Treasurer) plus one member at large, elected by the governing council to serve a single one year term. The Treasurer and the Executive Director, would be ex officio members.
7. There would be an Executive Director and an Assistant Executive Director, with duties spelled out for each—with the provision that on termination of the incumbent assistant, the Executive Director would assume all duties, or employ other staff members.
8. A Governing Council would consist of all officers, the chairman of the sections, and the president or the representative of each affiliate. This Council would conduct the affairs of the association through the Executive Board.
9. Voting for officers would be by mail ballot.
10. Voting in the general assembly would be—
    a. Each affiliate—5 votes for its first 25 members
    b. One additional vote for each additional 25 members
    c. In the case of more than one affiliate in a state, province, or region, the total votes would be divided by the number of affiliates—so that each would have equal representation.
11. Standing committees were set up, with membership in each designated. If anyone would be interested, we can discuss it further.
12. There should be no more than one affiliate in any state, territory, province, or region—except that if there are more at the time of merger, they would be permitted to retain their identity with split voting privileges noted above. Example—if there were two affiliates in Missouri, they would each have 2 1/2 basic votes for the first 25 members, plus one vote for each additional 25 members.
13. Provisions were made for the establishment of new affiliates in new areas, and for chapters within existing affiliates.
14. Specific procedures were spelled out for affiliate operation and for amending the by-laws.

I am sure every one of you is interested in why this proposal was not carried further.

The Joint Ad Hoc Committees were to report to their respective annual meetings on the seventh draft. Following a favorable acceptance by both associations, the seventh draft would have been published in the two journals, and a mail vote of each membership would be made.

At the NAS meeting in Washington in June, an Executive Committee of six people was appointed to study the draft and report to the business meeting. This group did not consult with their Ad Hoc Committee, and apparently reviewed the draft in the light of NAS ideas, rather than the new organization philosophy. As a result they brought back a list of recommendations for changes that were totally unacceptable to IAMFES—and nullified our intention to put the seventh draft to a vote at this meeting.

I would be willing to answer any questions of the members here, but before I do, I would like to emphasize that the seventh draft is a joint effort of both associations, and, if it is to be a starting place for a new attempt, we must approach the problem without recriminations and without giving the impression that this is an IAMFES document.

As I indicated at the beginning, your committee failed to reach its objective, and the fault we made was probably negotiating too well, as some of the provisions negotiated into the seventh draft, were just too revolutionary to be accepted by a few of the "old guard" in NAS. A failure to make a correct evaluation of your opposite number in any negotiation can often be more serious than poor negotiations.

W. C. LAWTON, *Chairman*
MILTON E. HELD
DICK B. WHITEHEAD
P. R. ELLIKER
H. L. THOMASSON

ACADEMY FOR SANITARIANS GROWING—TIME EXTENSION GRANTED

The American Intersociety Academy for Certification of Sanitarians, Inc., has shown very encouraging and substantial growth during the current year. Professional Sanitarians already certified as Founder Diplomates together with applications on file number about one hundred fifty. Through a recent change in the By-Laws, applicants for certification as Founder Diplomates now have until December 31, 1968 to apply. The original closing date was June 30, 1968.

The Academy was incorporated in March 1966 and began accepting applications in January 1967. The purpose of the Academy is to certify and give recognition to professional sanitarians whose educational background, competence and leadership have been demonstrated to be of outstanding quality in the field of Environmental Health.

For certification of Founder Diplomate, the minimum qualifications are a baccalaureate degree with not less than forty semester hours of academic credit in the physical and biological sciences plus twelve years of acceptable experience, eight of which have been in responsible charge of work. Other provisions are made for professional sanitarians holding a Masters or higher degree in which the number of years experience is reduced but an examination must be successfully passed in the general field of Environmental Health.

The Academy is an outgrowth of recommendations by the Sanitarians Joint Council the membership of which is composed of representatives from the International Association of Milk, Food and Environmental Sanitarians, the National Association of Sanitarians

and the American Public Health Association.

Professional sanitarians wishing more complete information about the Academy, its membership requirements and its objectives should address a request to Darold W. Taylor, Secretary, 2101 Wakefield Street, Alexandria, Virginia 22308.

NEWS AND EVENTS

FREEZE-DRIED FOODS HELP ASTRONAUTS SOLVE EATING PROBLEMS IN SPACE

Freeze-dried foods show great promise as nourishment for men in space. They have low bulk, are easy to prepare and store, and last indefinitely without refrigeration. Most important—when reconstituted with water, they have the same taste and texture as they did before freeze-drying. The whole problem of efficient nourishment of spacemen is being explored by the Life Support Department of Whirlpool Corporation, Benton Harbor, Mich., under a NASA contract. Some of the questions that must be answered are: How to provide enough food of sufficient variety for a mission, while keeping the weight and storage space of the food to a minimum. Which foods can be processed so they will not require heating or refrigeration. How to package food so astronauts can prepare it, eat it and dispose of "leftovers" under conditions of weightlessness and reduced pressure in the space vehicle.

Much of Whirlpool's Space Food Management Program is based on the use of freeze-dried food. Production techniques are similar to those used for freeze-dried coffee, dairy products, vegetables and seafood now used in many American homes. The major piece of equipment used in development and production is a Stokes food freeze-dryer, supplied by the Equipment Division of Pennsalt Chemicals Corporation, Philadelphia, Pa. Freeze-drying begins with freezing. After food is frozen, it is subjected to a *precise* combination of vacuum and heat, so that moisture frozen in the food is drawn off as a vapor without passing through the liquid phase. This prevents the loss of essential oils which give the food its original flavor when reconstituted with water. The food retains its original taste, color, texture and nutritive value, requires no refrigeration and is easily reconstituted when water is added. It is also lighter and requires less space. The space feeding program includes two basic types of foods: "rehydratable"—those to which water is added before eating; and bite-size foods—those eaten directly from the package in bit-size cubes.

Special Packaging

There's no kitchen in a spacecraft, so the astronaut's food must be easy to prepare and eat. To meet these requirements, Whirlpool has developed special packaging. Bite-sized foods are wrapped in plastic bags. Foods which have a tendency to crumble are first dipped in a special starch-like substance that prevents crumbs without affecting the foods' familiar texture. Crumbs floating about in the cabin could create a hazard to the astronauts.

Foods to which water must be added are in packages equipped with a special valve. The astronaut puts water into the container with a special probe-like water dispenser which he inserts in the valve. The water dispenser is designed to be dripless and leak-proof and the one-way valve on the package prevents water from escaping into the cabin while the astronaut applies pressure to force the food through a "zero G feeder" in the package. The water dispenser has a trigger mechanism which delivers one ounce shots from the water supply carried on board. This water is available at cabin temperature (70 F-80 F), cold (40 F-50 F), and hot (150 F-155 F).

Following instructions on the package, the astronaut adds the proper amount of water, kneads it to speed rehydration, then cuts open one end of the package and squeezes the food into his mouth through a "zero G feeding tube." When he is finished, he breaks an antimicrobial tablet into the food residue to retard putrefaction and places the container in a waste storage space. Mating "velcro" tabs, one on the wall and the other on the package, will hold the package firmly in place while the astronaut is preparing or eating other food items.

Like the astronaut, the food wears a "space suit." It consists of four layers of flexible plastic. The inner layer is chosen to be compatible with the food and to permit heat-sealing. The second layer provides burst strength. The third acts as a vapor barrier and the final layer is identical with the inner layer.

Flexible packaging is used because eating in a zero-gravity situation is somewhat like trying to eat while standing on your head. Being able to squeeze the food directly from the container and into the mouth helps to ease the difficulty.

Special Freeze-Dryer

Freeze-drying is primarily a vacuum process. The food is first frozen solid. It is then exposed to controlled conditions of pressure and temperature in a vacuum chamber. The product is heated, but pressure in the chamber is regulated so that the ice in the product does not become liquid but is converted directly from solid to vapor. As the process goes on, the outside of the product becomes completely dry while the inside continues to have solid ice in it. This prevents water-soluble substances from being removed, as they would be if the moisture was taken out in liquid form. It also prevents the physical structure of the product from being destroyed by shrinkage and thus makes it possible for the food to return to its original form when water is added.

Food can be freeze-dried under any of a wide range of temperature-pressure combinations. The task of the development part of Whirlpool's program is to find the combination which produces an acceptable product in reasonable time and at reasonable cost. The freeze-dryer is equipped with a temperature recorder-controller so that once an acceptable processing cycle has been established it can be repeated automatically.

The Stokes freeze-dryer has heating and refrigeration equipment which will provide and maintain product temperatures anywhere within the range of −30 F to +100 F. The vacuum system is designed to evacuate the chamber, condenser and interconnecting piping from atmospheric pressure (760 mm) to 1 mm pressure in just over three minutes.

Food to be processed is loaded in trays on any or all of the four product shelves in the chamber. A fifth shelf at the top of the chamber provides radiant heating to food on the upper product shelf. The shelves are coated with a highly emissive, heat and corrosion resistant finish, while the interior of the chamber is coated with a white, highly reflective finish. These special coatings assure the most efficient overall transfer of heat to the product.

A hot/cold blending type of heating system is used. It consists of an electrically heated heat exchanger, circulation pump, interconnecting piping, manual valves and temperature controls combined with a chilling circuit in which hot oil is blended with cool oil to achieve the required temperature control.

LABORATORY OF FREEZING POINT PIONEER UPDATES ORIGINAL INSTRUMENTATION WITH LATEST ADVANCED MILK CRYOSCOPE

The Minnesota State Department of Agriculture Dairy Laboratory in St. Paul, where Dr. Julius Hortvet developed the now world-famous Hortvet System to precisely determine the water content of milk by measuring its freezing point, has replaced an original Hortvet-type Cryoscope with the newest, most modern instrument available—an Advanced Milk Cryoscope.

Developed and manufactured by Advanced Instruments, Inc. of Newton Highlands, Massachusetts, this instrument is based on a modern concept of Dr. Hortvet's original freezing point research. The model replacing the original Hortvet unit is the Model 30LA Single-Sample Advanced Milk Cryoscope. Unlike its nearly quarter-century old predecessor, it measures the freezing point of a milk sample with push button simplicity. The Model 30LA is today the world's most widely-used milk cryoscope. It features new and simplified calibration plus a 3-year refrigeration warranty. It has a range of 0-1,000 H. Featuring modular construction, it weighs only 35 lbs. and measures 18" x 16" x 13".

Complete details, prices, and delivery information on the Model 30LA Advanced Milk Cryoscope are available by writing Robert J. Goldson Jr., Sales Manager, Advanced Instruments, Inc., 45 Kenneth Street, Newton Highlands, Massachusetts.

USDA UTILIZATION LAB IN WYNDMOOR, PA., TO HOLD OPEN HOUSE OCTOBER 24

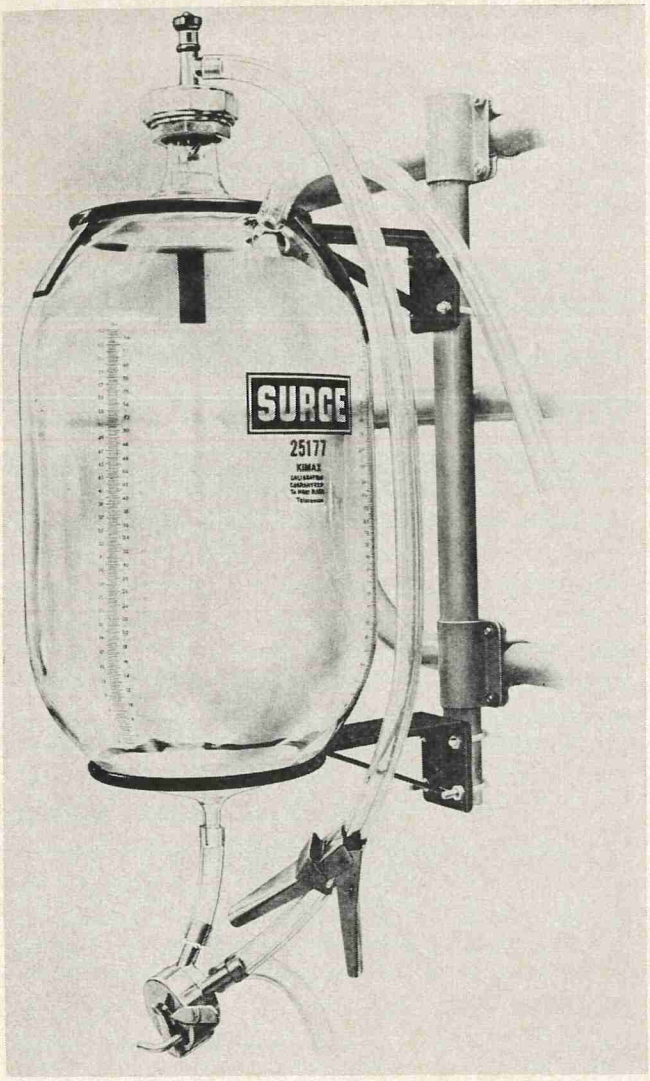
An Open House will be held at the Eastern utilization research laboratory of the U. S. Department of Agriculture at 600 East Mermaid Lane, Wyndmoor, Pa. (near Philadelphia) on October 24, from 2 to 4:30 and from 7:30 to 10 p.m.

Using the theme "Science at Work for You," the program will feature demonstrations of research in progress aimed at increasing the utilization of such farm commodities as milk, meat, hides, animal fats, and fruits and vegetables. Two shows, "Science at Work in Your Kitchen" and "Science at Work on Your Wardrobe," will be presented, one consisting of a food demonstration and talk and the other featuring a modeling of the latest fashions in leather, cotton, and wool. Popular science lectures and films will also be included in the program.

Facilities recently constructed at the Wyndmoor laboratory will be open for inspection. These include a new sanitary food-processing pilot plant and a separate meat-processing installation, complete with smokehouse, for the experimental manufacture of sausage products.

Advance programs describing the events to be featured at the Open House and instructions on reaching the laboratory are available free of charge. Write to Dr. P. A. Wells, Director, Eastern Utilization Research and Development Division, 600 East Mermaid Lane, Philadelphia, Pa. 19118.

SURGE ANNOUNCES NEW DHIA APPROVED WEIGHT JAR ASSEMBLY



A DHIA approved Weight Jar Assembly with extra large capacity and easy to read markings has been introduced by Babson Bros. Co., Oak Brook, Ill.

The Surge clean-in-place jar measures up to 65 pounds of milk with less than 1.4% variation, according to DHIA tests. Rigid steel mounting rings, safety coated with plastic, hold the jar solidly upright and keep it accurately calibrated. The rugged weight jar mounting assemblies clamp to almost any type milking stall.

The new Surge Weight Jar has milk level markings and numerals fire-polished on three sides, making it easier to calibrate, check and read. A unique milking vacuum by-pass design gives stable vacuum within the Surge Weight Jar. An approved milk sampling valve is also available to provide for proper mixing and convenient sampling for test purposes.

For additional information on the DHIA approved Surge Weight Jar Assembly, contact your Surge dealer or write to Babson Bros. Co., 2100 S. York Rd., Oak Brook, Illinois 60521, or Babson Bros. Co. Ltd., Rexdale, Ontario.

RECENTLY ADOPTED AMENDMENTS TO NATIONAL SANITATION FOUNDATION STANDARDS AND CRITERIA

Standard No. 2

Inclusion of provisions relating to Wood Top Bakers Tables and Cutting Boards. An Evaluation of Bakers Tables is currently underway, and Listings will be issued shortly.

Standard No. 4

Establishment of requirements for Fat Filters.

Standard No. 8

Amendment in requirements relative to portability and leg heights of equipment.

Criteria No. C-2

Amendment in requirements relating to "Louvers and Openings".

Copies of the referenced standards and criteria are also enclosed for your convenience and information.

The requirements relating to Standard No. 8 will become effective July 1, 1969; all other revisions become effective at once.

A MIXIN' TO START WEEK FOR EXPO VISITORS

Social events arranged for the week of Food & Dairy Industries Expo in Chicago will begin Sunday evening, October 13, with "A Mixin'", jointly sponsored by the Chicago Dairy Mixers and the Dairy Conventions Committee.

Although sponsored by the dairy segment of the food processing industry because of the concurrent dairy processing association conventions, all food processors are invited. Held in the Adams Ballroom of the Palmer House Towers, this informal reception will provide opportunity for everyone to assemble, meet old friends and make plans for the week.

The Chicago Dairy Mixers, most of whose members are active in other food processing areas, will serve as hosts. Admission is free and no tickets are needed. Guests will purchase drinks at a COD bar, but the hors d'oeuvres, strolling musicians and other extras are contributions of the sponsors.

Expo opens at 1:00 p.m., October 13 at the International Amphitheatre and is open each day through Thursday, October 17. It offers some 300 displays of supplies, equipment and services useful to food processors in procuring, storing, preparing, transporting and selling product lines.

CLASSIFIED ADS

SANITARIAN III—Immediate Opening—To establish and operate a new Sanitation Department, Rock Island County, Rock Island, Illinois. Offers a challenging position for the fully qualified person. Salary commensurable to start and up to $12,000, plus fringe benefits, car or full mileage allowance. Communication with qualifications should be directed to: President, Rock Island County Board of Health, County Office Building, Rock Island, Illinois 61201.

SANITATION SUPERINTENDENT

Responsible for developing and administrating a program for Central Soya's Chicago food ingredient processing plant, assuring compliance with the F.D.A., Health Department and company requirements. This individual will give staff direction to production superintendents regarding sanitation. Hiring to $10,000. Submit all resumes in confidence to: Richard A. Dent, Central Soya Company, Inc., 300 Fort Wayne Bank Building, Fort Wayne, Indiana 46802. An Equal Opportunity Employer.

DAIRY TECHNOLOGIST for busy Dairy and Food Control laboratory. Some travel—car allowance—good salary—profit sharing or partnership available. Owner retiring. Box 437 Shelbyville, Ind.

WANTED:—General Environmental Sanitarians for small City Health Department. Annual salary $8,050 to $8,650 plus car or car allowance, retirement, insurance and other liberal benefits. Contact E. Cornfield, M.D. Director of Health, City Hall, Bristol, Conn. 06010.

SANITARIANS—thirteen immediate openings in newly authorized meat inspection program. Salaries range from $5,732 to $13,263 with planned periodic salary increases. Excellent Civil Service benefits include paid annual and sick leave, life and health insurance, merit promotion and placement. Travel and relocation expenses may be authorized. Minimum qualifications: Bachelors degree, preferably with major in an academic field in health or related sciences. Specialized experience required for higher grades. Send Application for Federal Employment (obtainable at most Post Offices) or resume to: Recruiting Officer, D. C. Department of Public Health, Personnel Office, STOP 78, 801 North Capitol Street, Washington, D. C. 20001.

DIRECTOR OF ENVIRONMENTAL HEALTH. Challenging opportunity to develop and direct a comprehensive environmental health program in a progressive medium size southern New Jersey city. Position newly created. Supervise staff of 12 licensed sanitary inspectors plus ancillary clerical personnel. Extensive rodent control program recently submitted for funding. Assistance of qualified health educator available. Continuing professional development opportunities. Starting salary $9,450. Free medical coverage. Civil Service status with liberal fringe benefits. Car allowance. Requires bachelor degree plus courses and experience in sanitary sciences. Master degree in environmental health desirable. Contact Health Officer, Room 103 City Hall, Camden, N.J. 08101 or phone (609) 365-5140.

DAIRY SANITARIAN

Wanted to perform environmental sanitation inspections on dairy farms or in milk plant establishments. Desirable qualifications; Bachelor's degree with at least 45 quarter hours in science course work pertaining to environmental sanitation plus two years of work experience utilizing skills gained from academic training. Degrees relating to dairy or food technology preferred. Permanent work under a state merit system. Salary $6,900-$8,580. Starting rate above minimum is authorized commensurate with applicable qualificatios. Send resume to Personnel Officer, Oregon Department of Agriculture, Salem, Oregon 97310.

FOR SALE

Single Service milk sample tubes. For further information and a catalogue please write, Dairy Technology Inc., P.O. Box 101, Eugene, Oregon.

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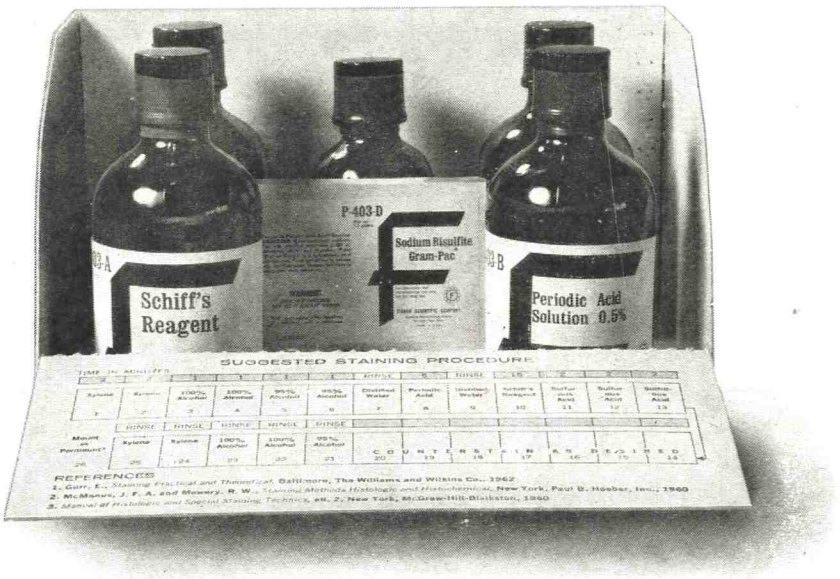

Pick up a Fisher LAB-PAC, easier, more convenient. And more stable on the table.

Here's a unique idea from Fisher Scientific to make your staining procedures a lot easier, a lot more reliable. It's a complete, self-contained carton called a "Lab-Pac," with all the stains and reagents you need, in the concentrations and quantities you need, to make eight staining runs.

Many of these solutions can be used right from the bottle. Others require some mixing, but you never have to formulate one from the very beginning. That's convenience.

Lab-Pac solutions have a long shelf-life. They are stable, and remain so, some for as long as two years. Since the reagents and stains in Lab-Pac have been formulated to standard specifications, the reproducible color concentration in stained tissues is always assured; the color intensity remains constant.

At the moment there are two Lab-Pac sets—one for Periodic Acid-Schiff ("PAS") staining, one for Masson's Trichrome Stain. You'll find complete staining instructions on the front panel of every Lab-Pac.

Pick up a carton of Lab-Pac, or write for our free product data. And remember, if your first thought isn't Fisher . . . think again. Fisher, first.

X-705

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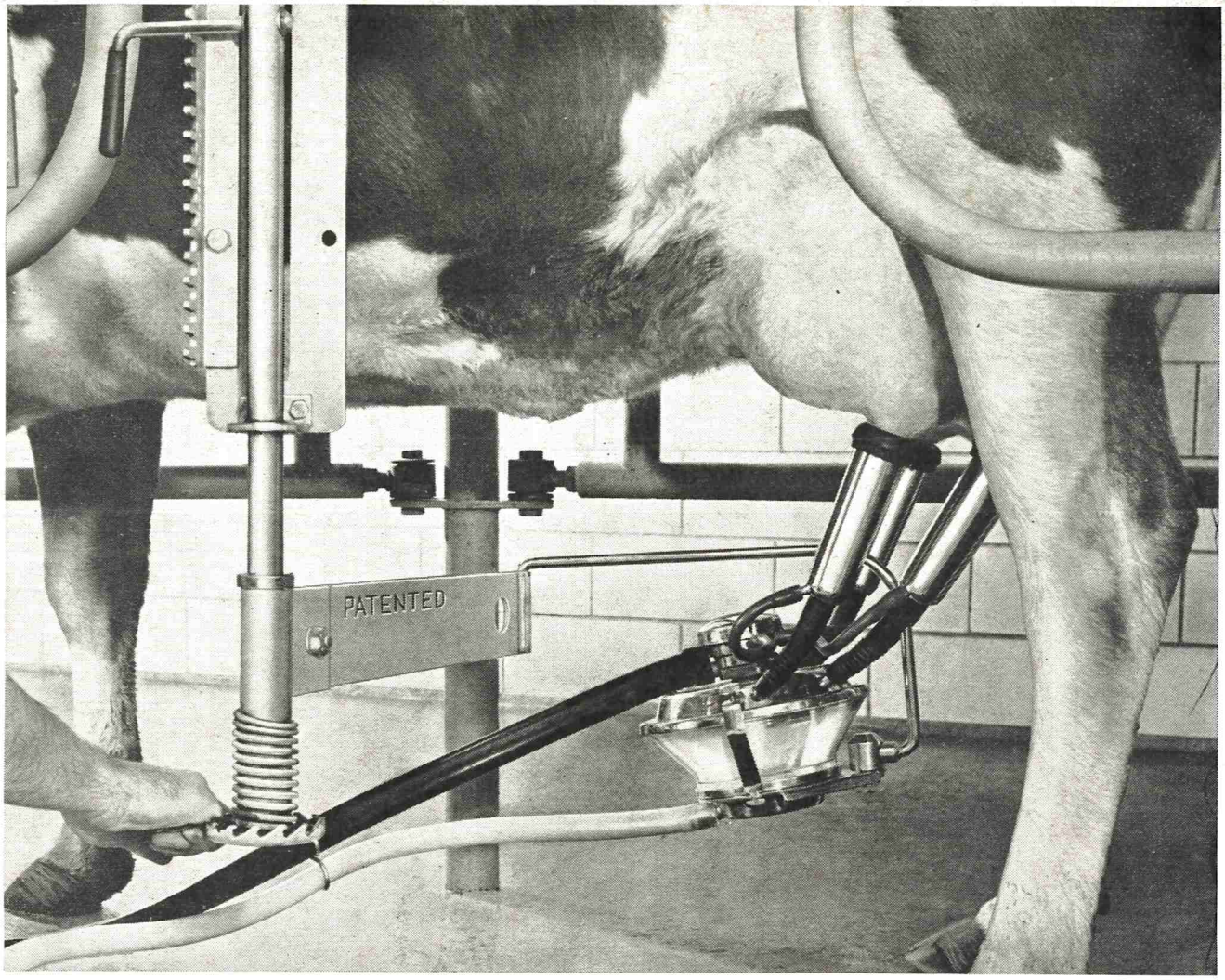

Why do more dairymen use Surge than all other brands combined?*

Surge does a better job of cow milking. It started in 1923 with the Suspended Bucket Milker. Nearly half a century of progress has produced the Surge Lo-Profile Breaker Cup. The patented Surge Randel Support makes the Breaker Cup best for milking parlors. Surcingle suspension makes it ideal for stanchion pipeline systems.

The Surge Breaker Cup breaks the column of milk for safer, faster milking. Milk flows quickly and smoothly away from the teat and empties into the breaker cup to prevent milk backwash; eliminates irritating vacuum fluctuation; guards against possible infection.

Pulsator is right on the unit. Vacuum moves only 8 inches from pulsator to teat cups. The result? Inflations open and close positively for full milk flow and gentle massaging of teat. You milk faster and safer with Surge.

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Extra large milk capacity provides enough reserve for even the fastest, heaviest producers in your herd.

No wonder more dairymen milk with Surge than all other brands combined.

For a free demonstration, see your Surge Dealer . . . for more information on Surge Dairy Equipment, use this coupon.

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