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61ST ANNUAL MEETING

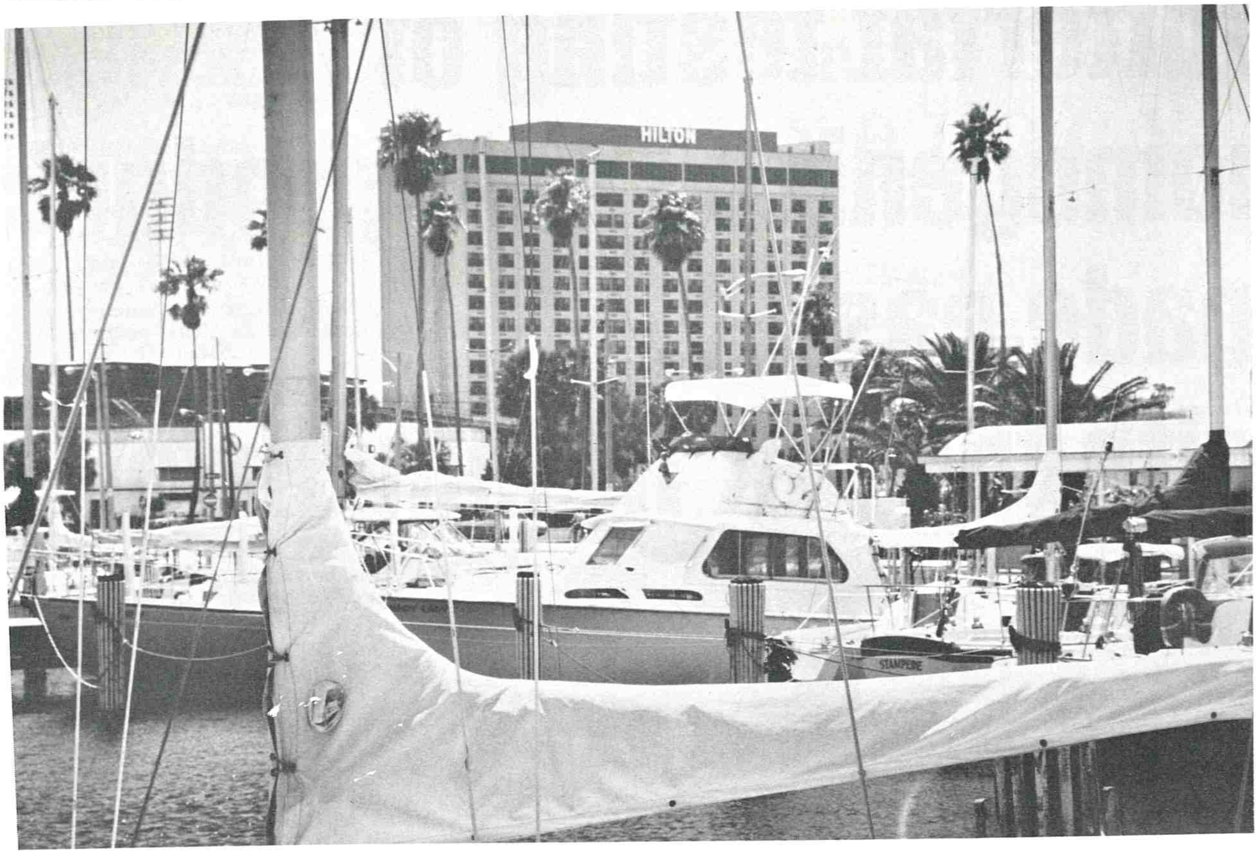
ST. PETERSBURG HILTON

August 12, 13, 14, 1974

St. Petersburg, Florida

(Reservations Page 1)

Official INTERNATIONAL ASSOCIATION MILK, FOOD & ENVIRONMENTAL SANITARIANS Publication



61st Annual Meeting

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

August 11–14, 1974

Host: FLORIDA ASSOCIATION OF MILK, FOOD AND ENVIRONMENTAL SANITARIANS

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MICROBIOLOGICAL QUALITY OF INDIAN MILK PRODUCTS[1]

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(Received for publication October 9, 1973)

ABSTRACT

A total of 245 samples of Indian milk products comprising *khoa, burfi,* and *pera* were examined for chemical, microbiological, and organoleptic qualities, and samples were graded as 'good,' 'fair,' and 'poor'. The chemical composition of these products varied considerably. Higher bacterial and fungal counts were noted in *khoa,* as compared to *burfi* and *pera.* A variety of microorganisms such as micrococci, sarcinae, aerobic spore-formers, coliforms, staphylococci, streptococci, and lactobacilli were isolated from the samples.

Khoa, burfi, and *pera* are popular milk products in many parts of India. *Khoa* is prepared from cow's or buffalo's milk by partial removal of water by heating and the product is consumed directly or used in the preparation of various milk-based sweets. *Burfi* and *pera* are prepared from *khoa* by addition of sugar. These products possess a characteristic type of flavor and taste, in addition to being whitish in appearance. *Burfi* is sold as flat, thick, slabs or cubicles, whereas *pera* is marketed in a variety of shapes and sizes. During manufacture and subsequent handling of these products, various types of microorganisms gain entry from different sources. Further, conditions under which they are sold, are far from satisfactory. Although there is some scattered information of a general nature on the bacteriological and chemical analysis of *khoa (1, 2, 7, 10),* there is a paucity of information on the nature of the microflora in these products.

The present investigation deals with chemical and bacteriological analysis with particularly reference to the incidence and distribution of different types of microorganisms in Indian milk products.

MATERIALS AND METHODS

A total of 245 market samples of Indian milk products, *khoa, burfi,* and *pera,* were collected from different parts of the country. Organoleptic grading and chemical analysis were according to procedures described by the Indian Standards Institution *(8, 9).* Samples were prepared for microbiological analysis according to Naidu and Ranganathan *(10).*

The following types of microorganisms were enumerated according to established procedures: proteolytic and acid-producing organisms *(5),* lipolytic types *(6),* aerobic sporeformers and thermophiles *(3),* coliforms *(4),* staphylococci *(11),* and yeasts and molds *(4).*

RESULTS AND DISCUSSION

A wide variation was noted in the chemical composition of market samples of *khoa, burfi, and pera* (Table 1). The average moisture content in *khoa* samples examined in the current study was 23.5% as compared to 40.0% reported in an earlier study *(7).* Since adequate moisture is known to favor growth of several types of microorganisms, control of moisture in *khoa* helps in reducing the bacterial load. In a similar study, Iyer et al. *(7)* also noted substantial variations in the moisture content (29 to 40%) of *khoa* samples and attributed this to non-availability of improved methods of preparation. According to Bhat et al. *(2),* the moisture content of *khoa* (mawa) was much less (19.7%) than normally recommended for some food products under ordinary conditions, while Rastogi et al. *(12)* noted a higher percentage of moisture (36.7 to 49.4%) in market *khoa* samples.

The percentages for fat, proteins, ash, and lactose for market *khoa* in the present study were 27.04, 18.99, 3.7, and 24.8, respectively. No sucrose was detected (Table 1). As *khoa* is also prepared from the milk of several breeds of cows and buffalos, it is likely that the composition of the product may vary according to the nature of milk *(2).*

The chemical analysis of *burfi* and *pera* revealed a wide variation in their composition *(12).* In the present study, the average moisture content in both these products was about 8.8% (Table 1). The percentage range of fat, protein, ash, lactose and sucrose in *burfi* and *pera* is also indicated in Table 1.

Titratable acidity (as per cent lactic acid) was higher (0.4%) in *khoa* as compared to *burfi* (0.27%) or *pera* (0.28%). The low acidity observed in *burfi* and *pera* samples may be due to the use of fresh *khoa* in their preparation and also due to the addition of sugar and probably starch. Nearly 60% of the samples of Indian milk products examined in this study showed the presence of starch which is considered an adulterant *(12),* since incorporation of starch is likely to contribute to further contamination of the product, thereby reducing its keep-

[1]N.D.R.I. Publication No. B-110.

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TABLE 1. CHEMICAL COMPOSITION OF INDIAN MILK PRODUCTS

Type of product		Constituents: Moisture (%)	Total solids (%)	Fat (%)	Proteins (%)	Ash (%)	Lactose (%)	Sucrose (%)	Acidity (% lactic acid)	Presence of starch
Khoa	Range	19.26-28.41	71.0 -79.6	25.6 -28.6	15.0 -23.14	3.0-5.0	23.5-27.2	0	0.3-2.00	±[1]
	Average	23.49	75.91	27.04	18.99	3.7	24.8	0	0.40	±
Burfi	Range	5.4 -18.4	80.0 -93.9	4.1 -13.2	12.1 -20.3	1.6-3.2	6.6-10.7	48.1-55.7	0.12-0.50	±
	Average	8.80	89.50	8.90	15.20	2.3	8.3	52.0	0.27	±
Pera	Range	6.8 -10.7	88.7 -92.5	3.3 -17.9	6.3 -11.8	1.4-3.4	7.3-11.7	52.1-60.5	0.12-0.40	±
	Average	8.80	90.50	9.70	9.10	2.0	9.4	55.3	0.28	±

[1]± = variable

TABLE 2. MICROBIOLOGICAL QUALITY OF INDIAN MILK PRODUCT - KHOA

Organoleptic grading	Range	Standard plate counts ($\times 10^3$)	Differential counts/g: Acid producers ($\times 10^3$)	Proteolytic types ($\times 10^3$)	Chromogenic types ($\times 10^3$)	Lipolytic types ($\times 10^3$)	Aerobic sporeformers ($\times 10^2$)	Thermophiles ($\times 10^2$)	Staphylococci ($\times 10^3$)
Good	Max.	30	15	8	6	4	0.8	1	5
	Min.	0.7	0.07	0.1	0.04	0.08	0.1	0.1	0.05
	Av.	5	0.8	1.4	1.3	1.2	0.3	0.4	0.7
Fair	Max.	300	200	200	60	200	500	8	180
	Min.	45	17	10	5	31	70	1.2	15
	Av.	148	77	41	20	72	15	2.7	67
Poor	Max.	150,000	135,000	89,000	110,000	125,000	11,000	100	98,000
	Min.	1,500	600	150	210	300	1,200	5	10
	Av.	11,000	5,000	2000	3,000	4,000	6,200	10	2,000

TABLE 3. MICROBIOLOGICAL QUALITY OF INDIAN MILK PRODUCT - BURFI

Organoleptic grading	Range	Standard plate counts ($\times 10^3$)	Differential counts/g: Acid producers ($\times 10^3$)	Proteolytic types ($\times 10^2$)	Chromogenic types ($\times 10^2$)	Lipolytic types ($\times 10^2$)	Aerobic sporeformers ($\times 10^2$)	Thermophiles ($\times 10^2$)	Staphylococci ($\times 10^2$)
Good	Max.	8	60	30	37	20	10	10	1
	Min.	2	15	4	1	1	0.3	0.3	0.3
	Av.	5	20	10	7	7	1	1.5	0.8
Fair	Max.	30	100	60	80	50	50	70	20
	Min.	3	8	6	1	6	1	2	1
	Av.	12.3	45	27	17	22	2	4	3
Poor	Max.	600	3,000	3,000	2,000	300	70	80	205
	Min.	13	30	10	9	9	1	1	2
	Av.	44	210	110	70	80	2	8	10

TABLE 4. MICROBIOLOGICAL QUALITY OF INDIAN MILK PRODUCT - PERA

Organoleptic grading	Range	Standard plate counts ($\times 10^3$)	Differential counts/g: Acid producers ($\times 10^2$)	Proteolytic types ($\times 10^2$)	Chromogenic types ($\times 10^2$)	Lipolytic types ($\times 10^2$)	Aerobic sporeformers ($\times 10^2$)	Thermophiles ($\times 10^2$)	Staphylococci ($\times 10^2$)
Good	Max.	9	30	20	30	30	10	10	2
	Min.	2	8	7	3	1	0.6	0.5	0.4
	Av.	5.6	12	11	10	2	1	2	0.9
Fair	Max.	26	140	60	57	55	30	50	30
	Min.	10	9	20	30	10	1	1	1
	Av.	14	38	33	30	26	2	5	5.5
Poor	Max.	300	2,800	1,000	2,000	130	80	90	300
	Min.	15	10	10	10	30	1	1	8
	Av.	56	150	130	90	80	3	9	30

TABLE 5. IDENTIFICATION OF DIFFERENT BACTERIAL ISOLATES IN INDIAN MILK PRODUCTS

Type species	No. of isolates in each group	Total	% Total
Micrococci and Sarcinae			
Micrococcus flavus	20		
Micrococcus citreus	9		
Micrococcus caseolyticus	17	84	23.01
Micrococcus luteus	29		
Micrococcus roseus	9		
Sarcina species	26	26	7.12
Staphylococci			
Staphylococcus aureus	8		
Staphylococcus species	10	34	9.31
Staphylococcus species	16		
Bacilli			
Bacillus subtilis	30		
Bacillus cereus	24		
Bacillus megatherium	19	103	28.21
Bacillus coagulans	10		
Bacillus stearothermophilus	20		
Coliforms			
Escherchia coli type 1	24		
Intermediate	14	57	15.89
Aerobacter aerogenes	13		
Unidentified	6		
Streptococci			
Streptococcus lactis	19		
Streptococcus cremoris	12	53	14.55
Streptococcus durans	8		
Unidentified	14		
Lactobacilli			
Lactobacillus acidophilus	3		
Lactobacillus bulgaricus	2	8	2.19
Unidentified	3		

ing quality.

A variety of microorganisms such as micrococci, sarcinae, aerobic spore-formers, coliforms, streptococci, lactobacilli, and staphylococci were encountered in samples of *khoa*, *burfi*, and *pera*. The number of such organisms varied depending on the type of product (Fig. 1). They were more in *khoa* than in *burfi* or *pera* (Tables 2, 3, and 4).

Samples of *khoa* examined in this study did not contain any sucrose. The high microbial counts in the samples may be due to subsequent contamination of the product during storage. *Khoa* samples graded as 'good,' 'fair,' and 'poor' showed 5,200, 150,000 and 11,000,000 organisms/g, respectively (Table 2). According to Naidu and Ranganathan *(10)*, the total bacterial counts in market *khoa* samples ranged from 1,300 to 1,500,000/g and no correlation was found between organoleptic quality and total bacterial count of the samples. The wide variation noticed in microbial counts in market *khoa* samples may be due to several factors such as difference in age of the samples at the time of collection, initial load of bacterial contamination through utensils and through improper handling, and also undesirable conditions of storage.

During the manufacture of *khoa*, milk is subjected to a substantial heat treatment, but aerobic spore-formers are known to survive such heat treatments. Among the different microorganisms encountered in *khoa* samples in the present study, spore-forming bacteria outnumbered other types, thereby suggesting that the survivors might have multiplied during subsequent storage. The possibility of contaminants (Tables 2, 3, and 4) gaining entry into these products during subsequent handling cannot also be ruled out. The aerobic spore-formers constituting 28.2% of the total microflora included *Bacillus subtilis*, *B. cereus*, *B. megatherium*, *B. coagulans*, and *B. stearothermophilus* (Table 5).

Out of 84 isolates of micrococci examined in this study, 29 were *Micrococcus luteus* and 20, *Micrococcus flavus*. The remaining cultures were identified as *Micrococcus caseolyticus* (17 isolates). There were also 9 isolates each of *Micrococcus citreus* and *Micrococcus roseus*. *Sarcina* species constituted only 7.1% of the total number of isolates. It is possible that

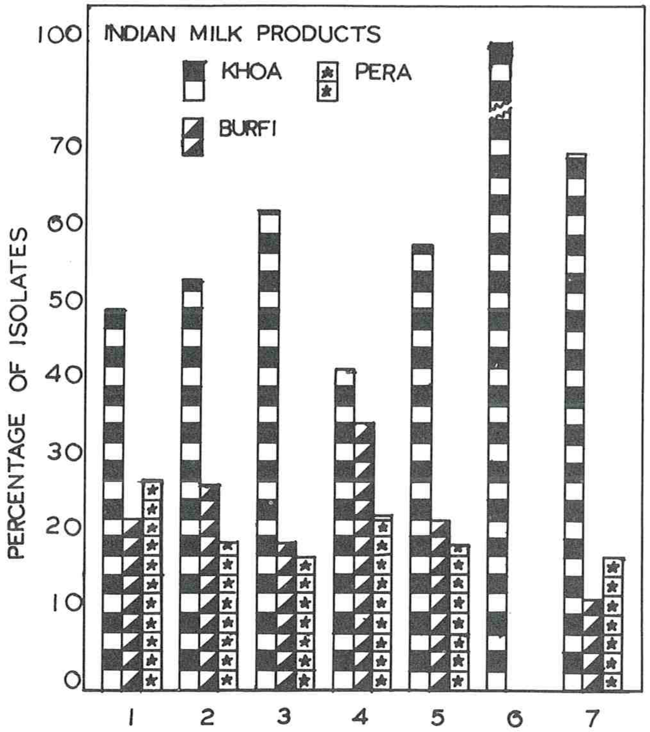

Figure 1. Distribution of different types of bacteria in Indian milk products. 1. Micrococci, 2. Sarcinae, 3. Aerobic sporeformers, 4. Coliforms. 5. Streptococci, 6. Lactobacilli, and 7. Staphylococci.

micrococci and sarcinae might have gained entry into Indian milk products through soil and other sources such as improperly cleaned utensils. In an earlier survey conducted on several samples of *khoa* from the Bombay market, Bhat et al. *(2)* reported the presence of several species of micrococci and bacilli and other types of microorganisms in the samples.

Among the coliforms encountered in the market samples examined in this study, *Escherichia coli* type 1 predominated, followed by intermediate types and *Aerobacter aerogenes*, apart from a few unidentified species (Table 5). Three out of 10 isolates of *Escherichia coli* showed a positive reaction with the mouse inoculation test. Detection of *E. coli* in foods such as *khoa, burfi,* and *pera* suggests fecal contamination and an earlier report by Bhat et al. *(2)* has already shown that a number of pathogens such as *Salmonella typhi, Shigella dysenteriae, Vibrio cholerae,* and *E. coli* are able to survive for long periods during the storage of *khoa.*

The incidence of streptococci and lactobacilli in Indian milk products were 14.55 and 2.19% of the total number of isolates, respectively (Table 5). Streptococci included species such as *Streptococcus lactis, Streptococcus cremoris* and *Streptococcus durans.* The isolates of lactobacilli were characterized as *Lactobacillus acidophilus* and *Lactobacillus bulgaricus.* Fourteen isolates of streptococci and three of lactobacilli could not be identified.

Among the 34 isolates of staphylococci examined in this study, 8 were identified as *Staphylococcus aureus* (Table 5). Staphylococci were present in all samples of the Indian milk products, although their numbers were higher in *khoa* than in *burfi* and *pera* (Tables 2, 3, and 4).

Presence of a large number of staphylococci as well as other spoilage organisms in Indian milk products thus poses a potential danger to consumers from a public health point of view, apart from causing wastage of such highly nutritious products.

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PHYSICOCHEMICAL AND BACTERIOLOGICAL ASPECTS OF PRESERVED MILK SAMPLES AND THEIR EFFECT ON FAT PERCENTAGE AS DETERMINED WITH THE MILKO-TESTER[1]

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Abstract

Milko-Tester results decrease as a milk sample ages before analysis. Since no fat is physically removed, this phenomenon could be termed apparent fat loss. Reasons are advanced why the Milko-Tester shows lower results on stored samples. Bacteria counts, oiling-off determinations, and acidity titrations were made on preserved milk samples to show their possible relationship to apparent fat loss. It is believed that changes in fat globule membrane material are key factors that affect the optical properties utilized by the Milko-Tester and are responsible for depressed fat percentages. High initial bacteria count may be the major and primary factor responsible for apparent fat loss in preserved samples held at room temperature. Bacteria have been demonstrated to grow in the presence of potassium dichromate preservative. Under certain conditions preserved milk samples showed no apparent fat loss and could be tested accurately with the Milko-Tester up to 20 days.

In recent years much attention has been directed to utilizing the phenomenon of light scattering for determining milk fat percentage. Much of this research has dealt with the Milko-Tester (M-T), its operation, accuracy, precision, and comparison with other methods *(2, 3, 4, 6, 9, 12, 14, 15, 17)*. Three Models of Milko-Testers are available (A/S N. Foss Electric, Hillerod, Denmark). Whenever errors were encountered it generally involved milk samples that had undergone some form of stress and change. Such stress factors may be one or a combination of the following: *(a)* length of storage period, *(b)* type and concentration of preservative, *(c)* temperature of storage, *(d)* deemulsification due to agitation (churning), *(e)* temperature shock (freeze-thaw cycles), *(f)* bacterial activity, *(g)* nature of milk (e.g., enzyme activity, salt balance), and *(h)* nature of fat globule membrane.

Ginn and Packard *(6)* demonstrated that the difference in results from Babcock and M-T procedures was greater for composite samples than for fresh samples, with composite samples giving lower M-T readings. Bakke *(3)*, Kroger *(8)*, and Packard and Ginn *(13)* have also noticed a decrease over time in M-T fat percentages for samples preserved with $K_2Cr_2O_7$ and stored at room temperature. Since fat was not physically removed from these samples, there was obviously an apparent loss of fat that was recognized by the M-T method.

The determination of milk fat with the M-T is based on optical phenomena. The M-T can be considered to be measuring the surface area of the fat globules in the milk sample. An aged sample must display the same physical characteristics as a fresh one, in order for the M-T to yield comparable results. Any reduction in the surface area or light scattering ability of the fat globules will result in a decrease in the M-T read-out and therefore in the fat percentage of the sample. The loss of surface area could be a direct result of fat globule rupture. Evidence of this occurrence is the appearance of free oil in or on the surface of the sample. Hence, without the appearance of free fat and when the fat percentage of a given sample decreases with time, it can only be an apparent loss of fat. The apparent loss of fat and decrease in reported fat content arises due to the rapid disappearance of homogeneity after mixing and the resulting impossibility of taking representative subsamples or aliquots; it may also be due to inability of the M-T to completely rehomogenize free fat into measurable fat globules *(17)*.

Not all errors are related to the decomposition of the sample. M-T results are dependent on the instrument's calibration. Also of importance is maintenance of optimum homogenizer efficiency.

Ginn and Packard *(6)* and Murphy and McGann *(11)* have discussed the difficulties that arise when the M-T is used to determine milk fat in both herd and individual cow samples. Curtis and Neff *(5)* have dealt with the discrepancies that occur at the high and low extremes of the fat scale. Errors occur at these extremes when the M-T has been calibrated to read most accurately in the medium range. If the M-T is calibrated to samples in a high fat range, low-fat samples will not be tested correctly. However, when limitations of the system are taken into consideration, the M-T can serve as an accurate tool to determine fat in raw milk.

This study was an investigation into the phenomenon of apparent fat loss in milk samples as evidenced with the M-T. It is hypothesized that the erroneous results obtained are partially due to physical changes of the milk fat globules. It is shown that bacterial

[1]Authorized for publication Sept. 21, 1973, as Paper No. 4536 in the Journal Series of the Pennsylvania Agricultural Experiment Station.

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cells in milk to be tested by M-T do not significantly interfere with the principles of the method. However, there are indications that the products of bacterial growth may be partially responsible for the physical changes that occur within a sample and particularly on the fat globules. The study specifically looks at the effect of $K_2Cr_2O_7$ concentration on retarding physicochemical changes within various milk samples.

EXPERIMENTAL

The following milk sample sources were used: *(a)* mixed herd milk, *(b)* individual Jersey cows, *(c)* individual Holstein cows, and *(d)* mixed herd milk standardized to above 6% fat with raw cream.

A research M-T Mk II, previously calibrated against the Mojonnier method *(10)*, was chosen for all fat determinations. A M-T Automatic was used in a reference check on one set of samples.

Milk samples were preserved with various concentrations of $K_2Cr_2O_7$ (0.051-0.397%) and $HgCl_2$ (0.296%). The preservatives were in the form of tablets that also included binders and fillers. Although whole tablets were used, preservative concentrations were calculated and are listed here as active ingredient percentages. The following additions to milk were made: *(a)* $K_2Cr_2O_7$: 0.051%–1 NASCO tablet[1] (41 mg $K_2Cr_2O_7$) 180 ml, 0.082%—1 NASCO tablet (41 mg $K_2Cr_2O_7$)/50 ml, 0.102%–2 NASCO tablets (82 mg $K_2Cr_2O_7$)/80 ml, 0.164%–2 NASCO tablets (82 mg $K_2Cr_2O_7$)/50 ml, 0.197%–1 UNEK tablet[2] (158 mg $K_2Cr_2O_7$)/80 ml, and 0.397%–1 NASCO plus 1 UNEK tablet/50 ml; and *(b)* $HgCl_2$: 0.292%–1 corrosive sublimate tablet[3] (234 mg $HgCl_2$)/80 ml.

All milk samples were prepared and kept in 6-oz Whirl Pak plastic bags (NASCO, Fort Atkinson, WI). Exact sample amounts were dispensed with an in-line graduated syringe from a continuously agitated cold milk supply. Preservative tablets were completely dissolved in the samples by gentle manual movement of the closed bags. Duplicate samples were prepared and analyzed.

Before all determinations, samples were placed for 5 min in a water bath maintained at 38 C and then shaken by hand by gently inverting each bag about six times. To standardize sample mixing conditions, the M-T Mk II intake was coupled with an electro-mechanical agitator.

The following series of experiments and determinations were conducted: *(a)* Mixed raw milk samples with normal and above-normal fat contents, preserved with $K_2Cr_2O_7$ at various concentrations, kept at 7 C and 27 C, and tested for fat at 1, 3, 5, 7, 9, 12, 15, and 20 days of storage with the M-T Mk II and M-T Automatic. *(b)* Individual Holstein and Jersey milk samples, preserved with 0.102% and 0.197% $K_2Cr_2O_7$ and 0.292% $HgCl_2$, kept at 7 C and 27 C, and tested for fat at 1, 3, 5, 7, 9, 12, 15, and 20 days of storage. *(c)* Standard plate counts (average of two) of mixed raw milk, preserved with 0.051%, 0.164%, and 0.397% $K_2Cr_2O_7$ kept at 27 C, bacteriologically tested at 1, 3, 5, 7, 9, 12, 15, and 20 days of storage. *(d)* Standard plate counts (average of two) of individual Holstein and Jersey milk samples, preserved with 0.102% and 0.197% $K_2Cr_2O_7$ and 0.295% $HgCl_2$, and kept at 7 C and 27 C, and bacteriologically tested at 1, 3, 5, 7, 9, 12, 15, and 20 days of storage. *(e)* Titratable acidity (average of two) of individual Holstein and Jersey milk samples (same as above), preserved with 0.102% and 0.197% $K_2Cr_2O_7$, kept at 7 C and 27 C, and titrated on 1, 3, 5, 7, 9, 12, 15, and 20 days of storage. *(f)* Oiling-off value determination (average of two) of individual Holstein and Jersey milk samples (same as in *d* and *e* above), preserved with 0.102% and 0.197% $K_2Cr_2O_7$, kept at 7 C and 27 C, and tested on 1, 3, 5, 7, 9, 12, 15, and 20 days of storage.

The standard plate count was carried out according to standard procedures *(1)* and titration of acidity according to accepted practices *(10)*. The oiling-off value was obtained through a modification of the oiling-off test for cream *(10)* as follows: 32.5 ml milk at room temperature was pipetted into an 8% Babcock milk test bottle and centrifuged for 5 min. Water at 160 F was added up to the base of the neck of the bottle followed by centrifuging for 15 sec (at top speed). Then more of the hot water was added, to bring the top level up into the graduated portion of the bottle, followed by 5 min of centrifugation. Before reading the oil layer, each bottle was placed for 1 min into a 150 F water bath. Each 0.1% oil (0.1% Babcock division) on the graduated scale was read as one point of oiling-off damage. Oil volumes of $<$ 1 point were considered to be traces of oiled-off milk fat.

RESULTS AND DISCUSSION

Data in Table 1 are the M-T fat percentages of mixed herd raw milk preserved with $K_2Cr_2O_7$ at different concentrations and stored for up to 20 days at room temperature (27 C) and in the refrigerator at 7 C. The effect of sample refrigeration is clearly demonstrated. One criterion of sample deterioration (usually an apparent fat loss) was the deviation of fat percentage by more than 0.5% from that of the initial sample aliquot. Using this criterion, any $K_2Cr_2O_7$-preserved herd milk sample, when kept refrigerated, could be reliably tested for fat with a M-T at least up to 20 days storage, even if the preservative was at a relatively low concentration. Samples kept at room temperature showed apparent fat losses much earlier when tested with the M-T. Increases in $K_2Cr_2O_7$ concentration did retard this problem for a few days.

Milk from individual cows reacted similarly (Table 2). However, samples from Jersey cows were more sensitive and showed apparent fat losses earlier than samples from Holstein-Friesian cows when stored at room temperature. The phenomenon of apparent fat loss seems to be tied to the physics and the chemistry of the fat globules.

Table 3 includes the results obtained with mercuric chloride. It can be seen that at the concentration used and also at lower concentrations, as noted in other trials, mercuric chloride is a better milk sample preservative. However, its use is being discouraged

[1]Potassium dichromate tablets (NASCO, Fort Atkinson, WI); 41% active ingredient, each tablet weighs 100 mg.

[2]Potassium dichromate tablets (UNEK Products Laboratories, Oconomowoc, WI); 65.9% active ingredient, each tablet weighs 240 mg.

[3]Corrosive sublimate tablets (Kirk White Chemical Co., Oconomovoc, WI); 46.7% active ingredient, $HgCl_2$, each tablet weighs 480 mg.

Table 1. Fat percentage (average of two) of mixed herd milk samples with different concentrations of potassium dichromate and stored at 27 C and 7 C for up to 20 days. Testing was performed with the M-T Mk II and MTA.

	$K_2Cr_2O_7$ (%)	Initial fat (%)	Days in storage 1	3	5	7	9	12	15	20
27 C M-T Mk II	0.051	4.10	4.06	4.06	4.06	4.12	4.01	CNT[a]	—	—
	0.082	4.16	4.15	4.17	4.17	4.18	4.21	4.21	3.85	CNT
	0.082	6.55	6.60	6.60	6.60	6.55	6.55	6.30	6.25	CNT
	0.164	3.82	3.79	3.84	3.87	3.88	3.85	3.85	3.81	3.69
	0.397	3.62	3.65	3.62	3.59	3.63	3.62	3.67	3.67	3.59
Average		4.45	4.45	4.46	4.46	4.47	4.45	—	—	—
7 C M-T Mk II	0.082	4.18	4.20	4.20	4.18	4.19	4.22	4.21	4.20	4.17
	0.082	6.89	6.90	6.92	6.90	6.92	6.92	6.91	6.87	6.87
	0.164	3.90	3.91	3.93	3.91	3.90	3.90	3.91	3.92	3.89
	0.397	3.60	3.60	3.61	3.64	3.62	3.65	3.65	3.65	3.55
Average		4.64	4.65	4.66	4.66	4.66	4.67	4.67	4.66	4.62
27 C M-T MTA	0.082	4.22	4.21	4.17	4.15	4.16	4.20	4.24	3.90	CNT
	0.082	6.25	6.26	6.23	6.23	6.30	6.30	6.33	5.60	CNT
Average		5.24	5.24	5.20	5.19	5.23	5.25	5.29	4.75	—
7 C M-T MTA	0.082	4.23	4.23	4.21	4.20	4.23	4.24	4.23	4.22	4.22
	0.082	6.67	6.61	6.65	6.62	6.66	6.72	6.63	6.72	6.72
Average		5.45	5.42	5.43	5.41	5.45	5.48	5.43	5.47	5.47

[a]CNT indicates that milk samples could not be tested with the Milko-tester.

Table 2. Fat percentage (average of two) of milk samples from individual cows (Jersey and Holstein) at two concentrations of potassium dichromate and stored at 27 C and 7 C for up to 20 days (Milko-Tester Mk II).

	$K_2Cr_2O_7$ (%)	Initial fat (%)	Days in storage 1	3	5	7	9	12	15	20
27 C										
Holstein	0.102	3.73	3.73	3.72	3.74	3.74	3.71	3.76	3.53	CNT[a]
Holstein	0.197	3.71	3.71	3.70	3.68	3.71	3.70	3.70	3.71	3.75
Average		3.72	3.72	3.71	3.71	3.73	3.71	3.73	3.72	—
Jersey	0.102	4.40	4.39	4.39	4.39	4.40	4.39	4.21	4.12	CNT
Jersey	0.197	4.50	4.50	4.50	4.48	4.48	4.47	4.42	4.39	CNT
Average		4.45	4.45	4.45	4.44	4.44	4.43	4.32	4.26	—
7 C										
Holstein	0.102	3.73	3.37	3.72	3.71	3.73	3.73	3.73	3.74	3.75
Holstein	0.197	3.73	3.71	3.71	3.70	3.71	3.71	3.71	3.75	3.70
Average		3.73	3.72	3.72	3.71	3.72	3.72	3.72	3.75	3.73
Jersey	0.102	4.43	4.43	4.46	4.43	4.43	4.40	4.40	4.40	4.39
Jersey	0.197	4.43	4.43	4.43	4.43	4.43	4.40	4.40	4.45	4.43
Average		4.43	4.43	4.45	4.43	4.43	4.40	4.40	4.43	4.41

[a]CNT indicates that milk samples could not be tested with the Milko-tester.

Table 3. Fat percentage (average of two) of milk samples from individual cows (Jersey and Holstein) preserved with mercuric chloride and stored at 27 C (Milko-Tester Mk II).

	$HgCl_2$ concentration	Initial fat (%)	Days in storage 1	3	5	7	9	12	15	20
27 C										
Holstein	0.292	3.73	3.73	3.71	3.70	3.73	3.73	3.73	3.75	3.70
Jersey	0.292	4.38	4.38	4.39	4.41	4.41	4.41	4.39	4.39	4.38
Average		4.05	4.06	4.05	4.06	4.07	4.07	4.06	4.07	4.04
7 C										
Holstein	0.292	3.73	3.73	3.73	3.75	3.73	3.73	3.75	3.77	3.72
Jersey	0.292	4.38	4.38	4.36	4.40	4.40	4.40	4.38	4.42	4.40
Average		4.05	4.06	4.05	4.08	4.07	4.07	4.06	4.10	4.06

because of a possible corrosive effect on the M-T and its possible role as an environmental contaminant when discarded.

The effect of increasing concentrations of $K_2Cr_2O_7$ on bacteria in milk samples is shown in Fig. 1. At the relatively low level of 0.051% there was almost no discernible bacteriostatic or bactericidal effect, as reflected by standard plate counts. Depending on initial numbers of bacteria and storage temperature, such preserved samples deteriorated relatively fast and could not be properly tested with a M-T after 7 to 12 days. The time of unsuitability for fat testing coincided with the end of the logarithmic growth phase. At a concentration of 0.164%, preservative action was maintained until day 3 with bacterial growth ensuing thereafter. These samples were unsuitable for testing after 12 days. At a still higher preservative level, 0.397%, there was no bacterial growth, only a gradual bactericidal effect, and the samples remained "stable" for the fat test up to 20 days, and probably beyond that time. It can be assumed, and it could be recommended, that for effective 20-day milk samples preservation with $K_2Cr_2O_7$ samples must contain 0.3-0.4% of that preservative.

The effects of sample refrigeration and $HgCl_2$ on bacterial numbers in individual Holstein cow milk samples are shown in Fig. 2. Mercuric chloride at 0.245% concentration was definitely better as a preservative than potassium dichromate at two lower concentrations. In all three of the comparisons, the refrigerated preserved samples contained lower numbers of bacteria. Data for individual Jersey milk samples were very similar and, for that reason, are not displayed here.

In general, the storage life of preserved samples depends on bacterial activity. As can be seen from these data the preserved milk samples are not always sterile, on the contrary, do support bacterial activity to varying degrees. This bacterial activity is believed to affect fat globule structure and properties and, thus, may influence milk fat determinations as carried out with the M-T.

Oiling-off in a milk sample is one manifestation of fat globule damage. Mechanical disruption has been dealt with elsewhere *(7)* and will not be discussed here. More subtle disruptions are believed to occur because of bacterial activity. Fat globules in Jersey and Guernsey milk are particularly vulnerable to such disruptive forces as mechanical abrasion, bacterial activity, and high temperature. Figures 3 and 4 show the oiling-off values for individual Holstein and Jersey milk samples preserved with different concentrations of chemicals and stored at room and refrigerator temperatures. The emulsion instability of Jersey milk is readily demonstrated, while Holstein milk is relatively stable in the oiling-off test. Milk with an oiling-off value up to 1 usually did not show an apparent fat loss during M-T fat determinations. It should be borne in mind that such fat losses may be caused by a number of factors. With Jersey milk stored at room temperature there were very noticeable increases in the oiling-off

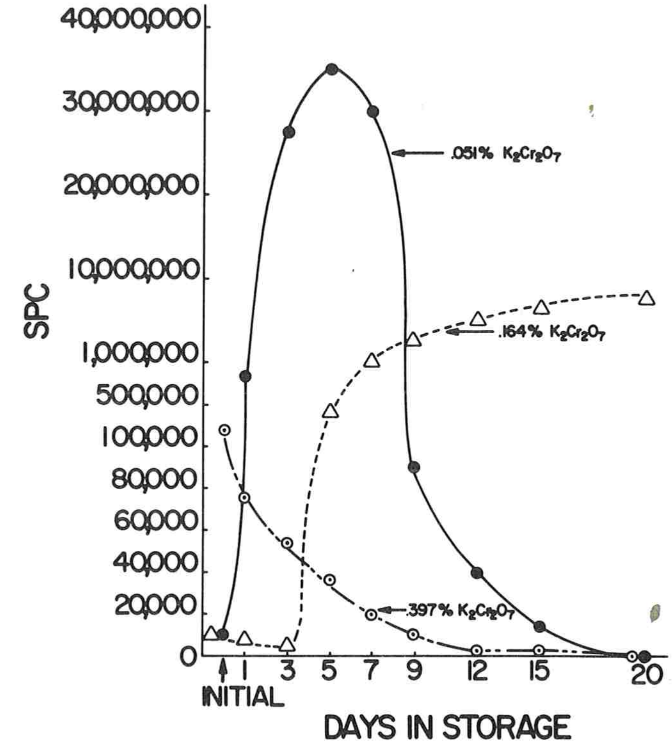

Figure 1. Standard Plate Counts (SPC) of mixed herd milk samples preserved with different concentrations of $K_2Cr_2O_7$ and stored at 27 C up to 20 days.

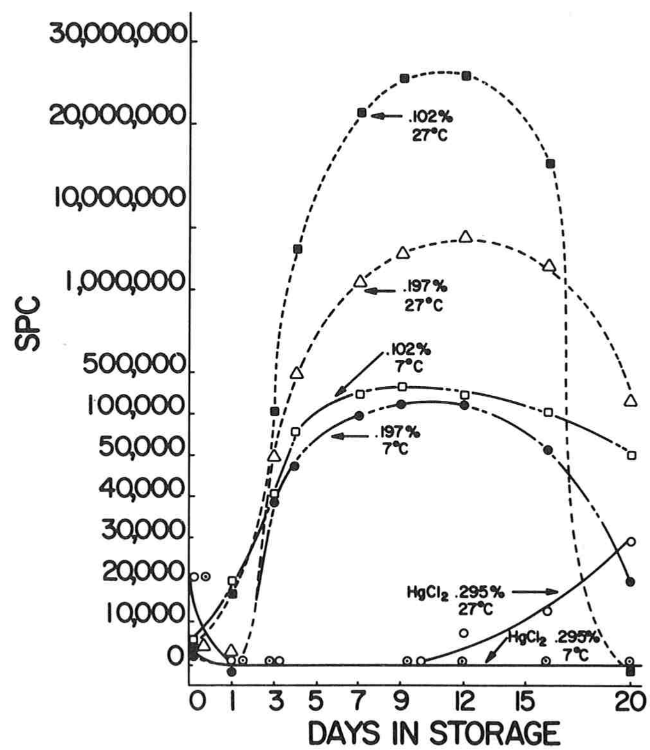

Figure 2. Standard Plate Counts (SPC) of individual Holstein milk samples preserved with different concentrations of $K_2Cr_2O_7$ and $HgCl_2$ and stored at 27 C and 7 C up to 30 days.

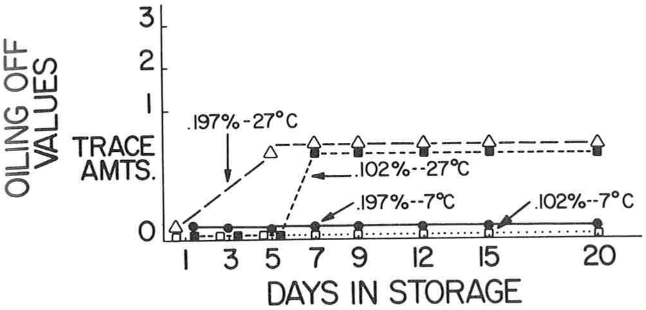

Figure 3. Oiling-off values (average of two) of individual Holstein milk samples preserved with different concentrations of $K_2Cr_2O_7$ and stored at 27 C and 7 C up to 20 days.

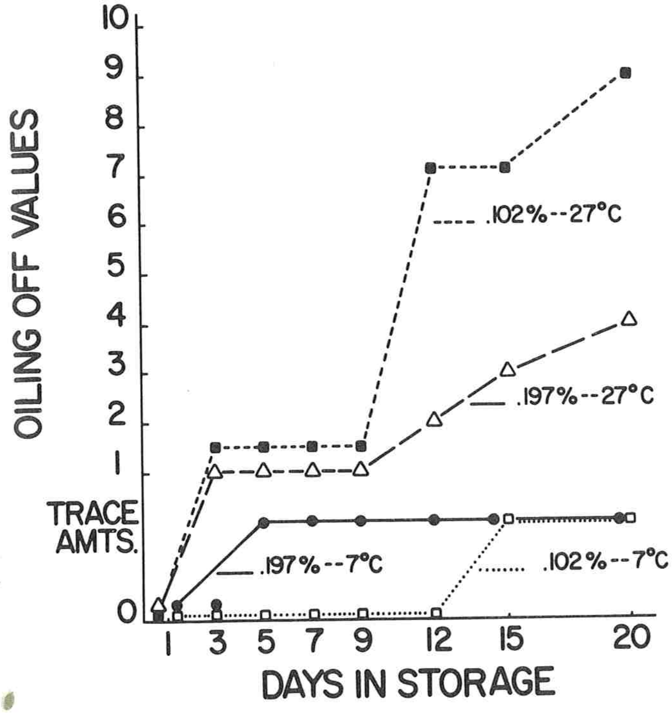

Figure 4. Oiling-off values (average of two) of individual Jersey milk samples preserved with different concentrations of $K_2Cr_2O_7$ and stored at 27 C and 7 C up to 20 days.

value after 9 days of storage. This coincided with a decrease from 4.39 to 4.21 on the twelfth day of storage (Table 2).

The percent titratable acidity (expressed as lactic acid) of the Jersey and Holstein samples shown in Table 2 and Fig. 3 and 4 are presented in Fig. 5 and 6. Usually large amounts of developed acidity were noted only in those samples kept at room temperature and preserved at the lower $K_2Cr_2O_7$ concentration. However, an increase in titratable acidity cannot be held solely responsible for apparent fat losses in stored, preserved milk samples. It is probable that increased acidity, as caused by bacterial growth, does bring about fat globule membrane denaturation or damage which in turn may lead to liberation of globular fat and the appearance

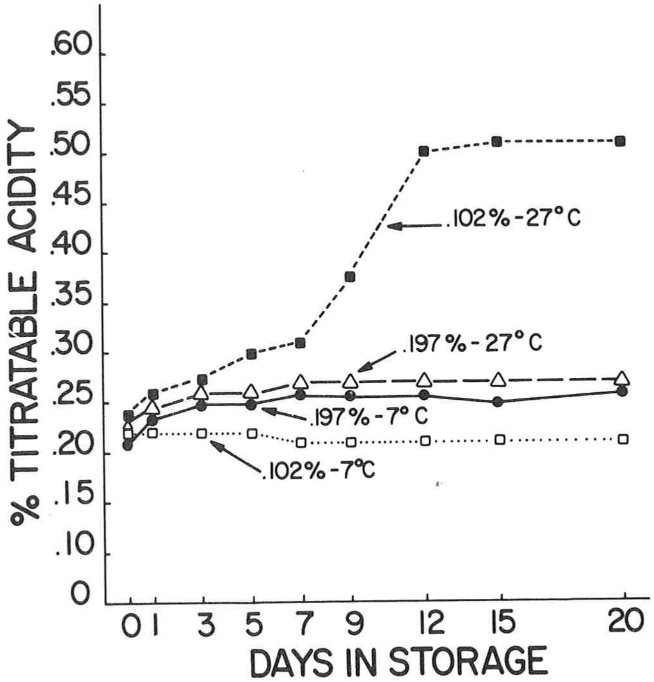

Figure 5. Titratable acidity values (average of two) of individual Holstein milk samples preserved with different concentrations of $K_2Cr_2O_7$ and stored at 27 C and 7 C up to 20 days.

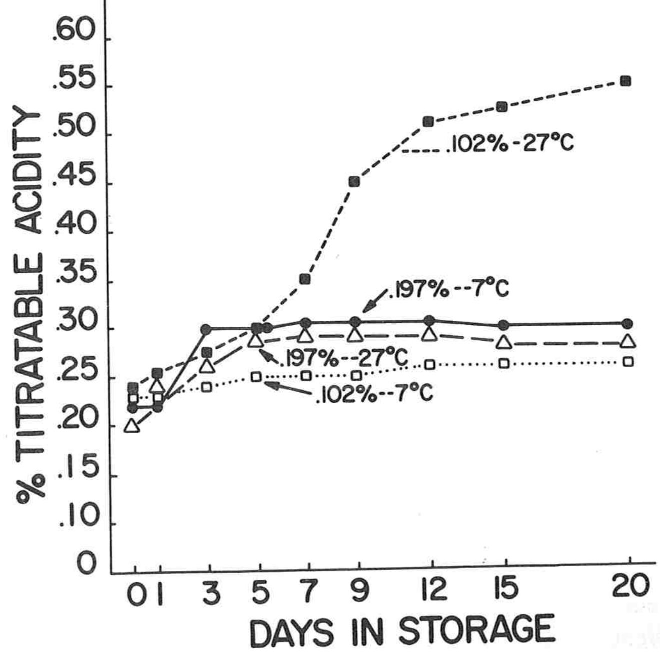

Figure 6. Titratable acidity values (average of two) of individual Jersey milk samples preserved with different concentrations of $K_2Cr_2O_7$ and stored at 27 C and 7 C up to 20 days.

of oiled-off, free fat. The nature of the fat globule membrane also seems to play a role, since Channel Islands breeds seem to produce fat globules more susceptible to damage.

In summary, this study explains in part the commonly observed apparent loss of fat in stored, preserved raw milk samples. At low concentrations of $K_2Cr_2O_7$ bacterial growth was rapid. Growth of bacteria is believed to be responsible for the increase in titratable acidity. Oiling-off parallels the increase in titratable acidity in some instances. The M-T "reads" only milk fat globular form. The denaturation of or damage to fat globules that is believed to occur reduces both the number of globules and the total globular surface area. This leads to a decrease in fat as recorded by the M-T, mainly because it is impossible to draw representative subsamples from oiled-off milk and because free fat is not efficiently reincorporated by the M-T homogenizer. It is also possible that acid or other damage done to the fat globule membrane, and not reversed by the M-T homogenizer, will be recognized by the M-T optical system and interpreted as fat loss. To completely avoid apparent fat loss for 20 days samples must be refrigerated. However, an increase in the concentration of $K_2Cr_2O_7$ or the use of $HgCl_2$ can be substituted for refrigeration. Increases in preservative concentration do not seem to affect M-T results. At a concentration of 0.397% $K_2Cr_2O_7$ a 20-day storage life was attained for mixed herd samples kept at room temperature (27 C). These results are an improvement over those reported earlier *(8)* probably indicating that the life of a preserved milk sample very much depends on initial bacteria count. The same may be assumed for individual cow milk samples.

Future work on this subject should include studies of fat globule size distributions in the milk of different breeds and the factors leading to fat globule breakdown. Walstra *(16)* has demonstrated a wide distribution of fat globule sizes within a sample. His results for individual Jersey milk samples showed that 6-8% of the globules are less than 1 μ in diameter and comprise 1-2% of the total fat percentage. Such facts are of importance in calibration, standardization, and checking of the M-T. It has been found in general practice *(11)* that mixed herd milk is the best choice for such purposes because of the wide range of fat globule sizes distributed in the milk, among other factors. If the smallest fat globules are assumed to be the ones most affected by bacterial activity, such as acid production, then a small effect can indeed have substantial results. This hypothesis remains to be tested. Traditionally it has been assumed that the largest fat globules are the most vulnerable ones leading to such problems as oiled-off fat.

One other future aspect to be studied is M-T homogenization. If low-pressure homogenization is capable of fat globule clump formation under certain conditions, as with acid-damaged fat globule membrane material, then the optical M-T response may reflect this smaller total surface area and result in erroneous milk fat determination.

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MICROBIOLOGY OF WYOMING BIG GAME MEAT[1]

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ABSTRACT

Total bacteria present on antelope, mule deer, and elk carcasses and in ground meat from these carcasses were determined. In addition to total aerobic plate counts, counts for coliforms, fecal coliforms, coagulase-positive staphlyococci, and *Salmonella* spp. were made. Average total aerobic plate counts of ground game ranged from 0.7 to 53 million organisms per gram. Surface swabs showed the bacterial counts to increase greatly during the 2-week aging period. Large numbers of coliforms and fecal coliforms were found in game meat. Nevertheless, game meat contained very few coagulase-positive staphylococci and no *Salmonella* spp. were detected.

The microbiology of domestic meat has been studied by several researchers *(3, 4, 6, 8)*. However, the mircobiology of game meat has not been studied extensively.

Kniewallner *(5)* found game meat to have an average count of 2.2×10^7 aerobic microorganisms/cm^2. He believed that numerous microorganisms exist in game meat and that the game meat trade in Europe would suffer if the meat were evaluated on the basis of results from bacteriological investigations. In support of these statements he cites Olt *(7)* who remarked that, on the basis of experience, one cannot judge game meat according to the usual principles of meat examination and bacteriological investigation.

Meat from big game animals in some parts of the United States is of considerable economic importance. For example, many custom meat processors in Wyoming depend on game meat processing for their livelihood. Approximately 28 million dollars were expended in 1970 to hunt and process big game in Wyoming *(2)*. Several other states will equal or exceed this figure *(10)*.

The purpose of this research was to investigate the relative occurence in, or on, big game meat of coagulase-positive staphylococci, *Salmonella* spp., and fecal coliforms, as well as total aerobic plate counts.

MATERIALS AND METHODS

Seven male and six female pronghorn antelope (*Antilocapra americana*) six male and six female mule deer (*Odocoileus heminous*), and six male and six female elk (*Cervus canadensis*) were obtained during fall hunting seasons from cooperating hunters who delivered the field-dressed carcasses to the University of Wyoming Meat Laboratory on the day of kill. The head of the field dressed carcass was removed. The carcass was split down the center of the back bone and one side of each carcass was skinned immediately. Both sides were washed with cold water and placed in a 3-C cooler at 70% relative humidity for aging.

Sterile swabs were used to sample the visceral cavity surface areas of both sides of each carcass after 1 and 14 days of aging. The four separate areas of each side that were swabbed included: *(a)* cut surface of the leg, *(b)* interior surface of the flank, *(c)* between the 12th and 13th rib, and *(d)* between the 5th and 6th rib. To obtain swab samples, sterile cotton swabs were moistened with sterile buffered water *(9)* and a surface area of 6.25 cm^2 was swabbed with the aid of sterile aluminum cutouts. One swab was used for each area and the area swabbed was gone over several times. The four inoculated swabs from each side were placed in the same sterile 16-mm tube, capped, and immediately frozen at -24 C. Swabs were analyzed in sets of three. These represented each side of a given carcass, namely, the hide-on side and the skinned side. A swab of the interior of the major wound was taken and frozen in a separate tube. Ten milliliters of nutrient broth (Difco) were added to each tube and the composite swab samples were agitated by a mechanical (Genie Vortex) test tube shaker at a setting of four for 2 min. The wound swab was agitated for 1 min. because, with only one swab in the tube, the amount of agitation was much greater than when 4 swabs were present in the same tube. Immediately after all 3 tubes from one carcass were agitated, the plating and dilution procedure for total aerobic bacteria was initiated *(9)*.

The hide-on side of each carcass was skinned at the end of the 2-week aging period and physically separated into bone, fat, and lean in an 11 C room. The fat and lean (minus tissue damaged by the rifle bullet) were then ground, mixed in a food mixer, and reground to obtain a homogeneous mixture. A sample of this mixture was used for bacterial analysis. Sides of beef, from the University Meat Laboratory, which had been aged at the same temperature and for the same period as the game sides were also ground and sampled for bacterial analysis. The ground meat samples were frozen in freezer paper at −24 C for approximately 2 months before analysis. Most big game meat is frozen for at least 2 months before being eaten and the freezing period for the ground game meat samples was included to more nearly duplicate the bacterial condition of the meat at the time it is removed from the freezer.

In addition to the ground game meat samples from the University Meat Laboratory, samples of ground beef, elk, deer, and antelope were obtained from three processing plants in Wyoming.

The domestic and ground game meat samples from plants other than the University were collected at random as processed. Samples were not collected at any particular day or time and the condition of the carcass of any animal which was sampled did not have any bearing on the decision whether or not to sample the meat. Samples approximately 0.45 kg in weight were collected either by the plant management or

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the authors. Persons who collected samples were instructed to place 0.45 kg of ground meat in a sterile plastic (Whirl-pac) bag and then place it in the freezer immediately. Samples were kept frozen until analyzed.

Ground homogenates of the meat samples from the processing plants and those from one side of each game animal processed at the University Meat Laboratory were analyzed for total aerobic bacteria, the coliform group, fecal coliform count, coagulase-positive staphylococci count, and for the presence of *Salmonella* spp. following USDA *(9)* procedures. The selective media used were Lauryl Sulfate Tryptose Broth (Difco) for coliforms; E. C. Broth (Difco) for fecal coliforms; Vogel Johnson Agar (Difco) for *Staphylococcus* in conjunction with Coagulase Plasma (Difco); and Brillant Green Sulfide Agar (Difco) and XLD Agar (Difco) to see if characteristic *Salmonella* colonies were formed. The procedure allowed for the detection of one Salmonella per gram. Coliforms, fecal coliforms, and coagulase-positive staphylococci were enumerated by a tube dilution method. Therefore, the numbers of organisms are reported in multiples of 10 using the most probable number method.

RESULTS AND DISCUSSION

In general, standard plate counts of ground meat from the University Meat Laboratory were higher than the corresponding counts for meat obtained from commercial plants (Table 1). The higher total counts for carasses processed at the meat laboratory are probably due to the 2-week aging period. Commercial plants do not normally age game carcasses over 1 week. The exact aging time for the meat samples taken at random from plants 1, 2, and 3 is not known. Variability in bacterial counts between the three commercial plants may also be due to aging time. However, it is more likely that variation in sanitation and/or handling practices in the plants are responsible for the differences. The standard deviations of the plate counts in many instances were greater than the average plate count values. The large standard deviations reflect the extreme variability that was found in ground meat. Standard plate counts of ground game were generally higher than the counts for ground beef. Higher counts for game probably reflect a higher degree of intial contamination for game than beef. However pH values for deer (5.9) and antelope (5.9) meat were also higher than those normally reported for beef. Antelope and mule deer meat also had higher standard plate counts than elk meat. The pH of elk meat (5.5) compares favorably with the pH of 5.4 given for the chiled carcasses of unstressed beef animals *(1)*.

Coliform numbers followed the same distribution as the total aerobic plate counts (Table 2). Most coliform counts for ground antelope, mule deer, and elk meat were 1×10^4/g or less. Only two game samples had a count as high as 1×10^6 coliforms/g. Ground beef had lower coliform and fecal coliform counts than ground game.

The figures in Table 3 are the results of tube-dilution counts of ground game samples for coagulase-positive staphylococci. Sixty game samples had <10 coaglase-positive staphylococci/g of ground meat. The notation <10 refers to those samples that were not positive at a 10^{-1} dilution. Five game samples, but none of the beef samples had 1000 or more coagulase-positive staphylococci/g of meat. These data indicate that coagulase-positive staphylococci were not present in ground game samples in excessive numbers. *Salmonella* spp. were not detected in any of the ground game meat samples.

Carcass swab bacterial counts (not shown in tabular form) increased greatly over the 2-week aging

TABLE 1. MEANS AND STANDARD DEVIATIONS FOR STANDARD PLATE COUNTS PER GRAM OF GROUND MEAT FROM BIG GAME AND BEEF AT DIFFERENT PLANTS

Location	Type of animal	Number of samples	Standard plate count: Mean	Standard plate count: Standard deviation
University meat lab.	Antelope	13	3.3×10^7	3.0×10^7
	Mule deer	12	5.3×10^7	6.3×10^7
	Elk	12	1.6×10^6	1.4×10^6
	Beef	6	1.2×10^5	1.6×10^5
Plant 1	Antelope	9	5.0×10^6	8.5×10^6
	Mule deer	19	3.5×10^5	1.1×10^5
	Elk	12	4.3×10^6	1.3×10^7
	Beef	4	3.7×10^5	2.8×10^5
Plant 2	Antelope	17	1.0×10^7	1.4×10^7
	Mule deer	4	5.0×10^6	3.3×10^6
	Elk	2	1.8×10^5	3.5×10^5
	Beef	6	5.5×10^6	7.7×10^6
Plant 3	Mule deer	8	7.3×10^5	4.7×10^5
	Elk	9	8.7×10^5	3.2×10^5
	Beef	3	8.1×10^4	6.2×10^4

TABLE 2. DISTRIBUTION OF COLIFORMS IN GROUND GAME AND GROUND BEEF

Organisms/g	Number of game samples: Coliforms	Number of game samples: Fecal coliforms	Number of beef samples: Coliforms	Number of beef samples: Fecal coliforms
<10	7	24	10	14
10	16	34	4	3
100	25	27	2	2
1,000	30	20	1	0
10,000	27	6	1	0
100,000	6	2	1	0
1,000,000	2	0	0	0

TABLE 3. DISTRIBUTION OF COAGULASE-POSITIVE STAPHYLOCOCCI IN GROUND GAME AND GROUND BEEF

Organisms/g	Number of game samples	Number of beef samples
<10	60	7
10	30	9
100	17	3
1,000	5	0
10,000	0	0

period. Average 24-h swab count on the surface of all game was $5.5\times10^{1}/cm^{2}$. The average surface swab count for these carcasses increased to $2.8\times10^{6}/cm^{2}$ after the carcasses were aged 2 weeks. The increase in counts during aging points out that decreasing the aging periods for game carcasses will greatly improve the bacteriological condition of the meat. It is obvious that all surface counts would have been higher had the swabs not been frozen at –24 C for a few weeks before plating. Since all swabs were frozen for the same length of time, bacterial death probably occurred at a proportional rate in both the 24-h and 2-week swabs. Presence or absence of the hide did not affect the bacterial counts on the interior surface of the carcass.

Bacterial counts from the wound swabs increased greatly as carcass aging time increased from 24-h to 2 weeks. The increase was from an average of 5.0×10^{2} cells per swab at 24-h to an average of 1.0×10^{7} cells per swab at 2 weeks. Counts would have been even higher had the swabs not been stored in the frozen state. Obviously, game carcass wounds should be trimed before any aging period the carcass undergoes. Reducing the game carcass aging period from 2 weeks to 1 week or less would also reduce bacterial growth on the carcass. At present there does not apear to be any evidence that there is a public health risk in eating properly cooked game meat. Nevertheless, adequate precautions should be taken during eviscertion, processing, handling, and storage.

ACKNOWLEDGMENTS

The financial assistance provided by the Federal Aid in Wildlife Restoration Project, Wyoming FW-3-R and the Wyoming Department of Agriculture made this project possible.

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RECOVERY OF COXSACKIEVIRUS B5 FROM STORED LETTUCE

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Abstract

Coxsackievirus B5 was recovered from laboratory-contaminated lettuce, after storage at 4 C, by washing with phosphate-buffered saline containing 1% fetal bovine serum at pH 8. Water was less efficient as a wash. No loss of virus occurred when contaminated lettuce was stored for 16 days under moist conditions, but a first-order inactivation took place during storage under dry conditions.

Reports of human enterovirus recovery from oysters *(11)*, ground beef *(9, 12)*, and vegetables *(2)* suggest that such foods, when contaminated, may be hazardous to health. Experimental studies in the USSR showed that soil may retain virus for 4-5 months *(1)*. In a later study, human enterovirus was recovered from soil and vegetables grown in fields that were irrigated with human sewage *(2)*. Contamination of vegetables might also occur at a later stage during washing, packing, or shipping.

Since many fresh vegetables are eaten raw, their contamination with infectious virus might lead to disease. We investigated some of the factors that affect survival of coxsackievirus B5 on lettuce and studied methods for effective recovery of contaminating virus.

Materials and Methods

Virus

Coxsackievirus type B5, obtained from Microbiological Associates, Inc., Bethesda, Md., was grown in HEp-2 cells. Stocks were stored in sealed ampoules at –70 C. Dilutions were made in phosphate-buffered saline (PBS) or water as indicated.

Cell culture

HEp-2 cells from Microbiological Associates were propagated in medium 199 containing 10% fetal bovine serum. Stock cultures were grown in Roux bottles as monolayers at 36 C.

Virus assay

Monolayers were prepared in 60 × 15 mm plastic dishes 24 h before assay and contained 3.0×10^6 cells at the time of use. Each dish was drained of fluid and received 2.5 ml of virus-containing sample. Virus was adsorbed onto cells by shaking the monolayers for 2 h and applying an agar overlay as described previously *(8)*.

Lettuce contamination and virus recovery

Leaves from a head of lettuce were rinsed in water, cut into 16-mm diameter discs, air dried under laminar flow for 10 min and placed flat on the bottom of a 35-ml screw-capped bottle. A virus inoculum of 100 plaque-forming units (PFU) in 0.1 ml of PBS was added to each disc. An equal inoculum was added to 5 ml of growth medium in the same type of bottle. Caps were replaced and tightened and bottles were stored at 4 C for 2 days. Virus recovery was attempted from the leaf samples with 4 ml of water or saline with or without 1% serum at pH 4, 7, and 8 or with PBS with or without 1% serum at pH 7 and 8. Samples were shaken mechanically with the eluent for 10, 30, or 60 min. Each eluent was removed, mixed with 1 ml of 5× growth medium and assayed for virus on two monolayers. Counts were compared with those of the virus control.

Storage of virus-inoculated lettuce

Lettuce leaf discs of 16 and 50 mm were prepared as described above. The larger discs were placed in 125-ml screw-capped Erlenmeyer flasks. A virus inoculum of 100 PFU in PBS was used for each disc. A volume of 0.05 or 0.1 ml was added to each 16 mm disc (0.025 or 0.05 ml/cm^2 of lettuce surface) and 0.1 or 1 ml to each 50 mm disc (0.005 or 0.05 ml/cm^2 of lettuce surface). The inoculum was spread over the upper leaf surface with a platinum loop. Samples were stored at 4 C and assayed at intervals of 4, 6, 7, 9, 13, and 16 days. Virus was recovered by shaking the 16-mm discs with 4 ml and the 50-mm disc with 40 ml of PBS containing 1% serum, pH 8, for 10 min. The 4-ml wash was assayed as described above. The large wash was reduced to 8 ml by ultrafiltration with a type PM30 membrane (American Corp., Lexington, Mass). Two ml of 5× concentrated medium were added, and samples assayed on four monolayers.

Irradiation of lettuce discs

Lettuce discs (16-mm diameter) were irradiated on each side with ultraviolet light from an 18-inch 15 watt Sylvania germicidal lamp at a distance of 12 inches for 2 min. Irradiated and non-irradiated discs were inoculated with a virus suspension of 0.1 or 0.05 ml in PBS as described above and compared for virus survival after storage for up to 16 days.

Preparation of lettuce extract

Lettuce was ground in a Waring blender with distilled water in a ratio of 2:1 and centrifuged at 1000 × *g* for 20 min to remove solids. A second centrifugation of the supernatant at 15000 × *g* for 20 min was applied to remove bacteria and solids. Two milliliters of the extract (pH 6.2) and 2 ml of growth medium were each inoculated with 500 PFU of virus in 0.1 ml of PBS and stored at 4 C for 4 days. After a dilution of 1:10 in growth medium, 2.5 ml portions were assayed on four monolayers.

Moisture maintenance of lettuce samples

The effects of three different moisture levels were investigated. Two 40-mm petri dish bottoms were placed in a 90-mm diameter petri dish. A lettuce disc (16-mm diameter) was put into one of the 40-mm dishes. Unlike the above experiments, virus was diluted in water rather than PBS to avoid the possible deleterious effect on virus of concentrating salts during evaporation of water. The virus inoculum (100 PFU in 0.05 ml) was placed on the lettuce disc or directly on the glass surface if there was no lettuce. Humidity conditions were maintained as follows: no moisture, by placing Drierite in the outer dish; low moisture, by using the inoculum as the sole source of moisture; and high moisture, obtained in two ways, by placing water in the outer dish or by the addition of 4 ml of water to the virus inoculum. All units were sealed in plastic bags and stored at 4 C for 7 days. Virus was recovered by washing the dishes which contained the virus inoculum with PBS containing 1% serum at pH 8 as described above.

In several experiments, the virus inoculum was introduced between two lettuce leaves; these were then placed in plastic bags at 4 C and stored 16 days. Virus was recovered as described above with a volume of 2 ml/cm^2 of leaf surface (one side only). The wash was reduced by ultrafiltration and assayed.

RESULTS

Coxsackievirus B5, inoculated onto lettuce discs in a suspension of 0.05 ml of PBS/cm^2, was recovered after 2 days of storage by washing with PBS containing 1% serum at pH 8. A shake period of 10 min with 2 ml of eluent/cm^2 of leaf surface removed 90% or more of the input virus. Virus recovery with water or saline was less efficient (Table 1). With all eluents a high pH was advantageous. Virus recovery at pH 4 was low.

When lettuce samples, 16- or 50-mm diameter were inoculated with a virus suspension of 0.05 ml of PBS/cm^2 of leaf surface and stored in sealed containers, most of the input virus could be removed at pH 8 with PBS containing 1% serum after 16 days of storage, the time limit of the experiment. When the volume of virus inoculum was reduced to 0.025 ml or less/cm^2 of leaf surface, recovery decreased with time of storage in a first-order reaction (Fig. 1). Although all of the samples remained turgid throughout the experiment, only those receiving the largest volume of inoculum were noticeably wet.

Irradiation of lettuce did not enhance survival of virus; recoveries from non-irradiated and irradiated samples were about equal, and both were dependent on the volume of the virus inoculum.

A water extract of lettuce was not deleterious to coxsackievirus B5 after 4 days of storage.

Table 2 shows that the survival of virus inoculated in water on lettuce or glass was optimum at high moisture levels. The four values obtained after storage in the two different high moisture conditions, described above, did not differ significantly from one another. The atmosphere in each was saturated with moisture as indicated by the presence of condensate on the lid of the container. The lettuce disc exposed to Drierite was noticeably dry and curled. Under the low moisture condition the lettuce appeared turgid but no condensate was evident. In experiments where the virus inoculum was introduced between two lettuce leaves and stored in plastic bags at 4 C, recovery after 16 days storage was essentially quantitative.

TABLE 1. COXSACKIEVIRUS B5 RECOVERY FROM LETTUCE AS PERCENT OF INPUT VIRUS WITH DIFFERENT ELUENTS AT VARIOUS pH LEVELS

	pH		
Eluent	4	7	8
Water	9	33	51
Saline	8	37	44
Saline with serum	10	32	50
PBS	—	49	84
PBS with serum	—	47	100

TABLE 2. EFFECT OF MOISTURE ON PERCENT SURVIVAL OF COXSACKIEVIRUS B5 ON LETTUCE OR GLASS AFTER 7 DAYS STORAGE

Moisture level	On lettuce	On glass
None	<0.8	<0.8
Low	36	4
High[1]	91	100
High[2]	100	95

[1]Water placed in an outer dish to provide a saturated atmosphere for samples.
[2]Samples immersed in water.

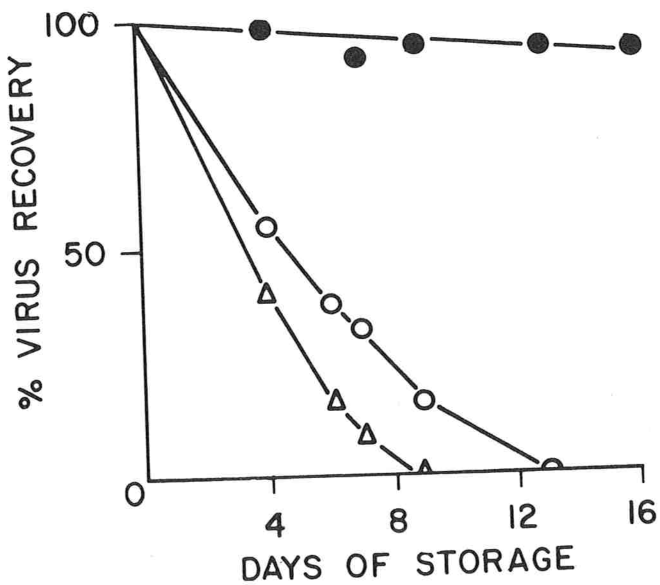

Figure 1. Effect of inoclum size on survival of coxsackievirus B5 on lettuce during storage at 4 C. Inoculum/cm^2 on leaf: 0.05 ml, closed circles; 0.025 ml, open circles; and 0.005 ml, open triangles.

DISCUSSION

Coxsackievirus B5 persisted on lettuce stored at 4 C when the leaves were moist. Our experiments indicated that under conditions of low or no moisture the aqueous portion of the virus inoculum evaporated leaving the virus exposed to salts and air or, in the absence of salts, to air alone. Both conditions were deleterious to virus survival. The volume of the inoculum was an important factor in contributing to the moisture content and therefore the survival of virus on lettuce or glass. Since low moisture accelerates deterioration of lettuce, it is in the interests of both producer and food distributor to ensure that the vegetable is kept fresh by chilling and moisturizing. However, both factors favor virus survival.

Experimental studies have shown that enteroviruses persist in a wide variety of foods, especially under refrigeration *(4-7, 10)*. The virus inoculum was usually mixed into the food and was thus protected from dessication. Kiseleva *(7)*, however, inoculated virus on bread pieces which were then stored either in the open or in a closed container. Virus persisted well on bread stored in the closed container but deteriorated relatively rapidly when stored in the open. This inactivation of virus was attributed to dessication.

Several studies gave no indication that spoilage of food affected virus survival *(4, 5, 7, 10)*. However, Cliver and Herrmann *(3)* showed that coxsackievirus A9 was inactivated by growing cultures of proteolytic bacteria. Our work showed that irradiation of the lettuce surface had no effect on virus survival beyond that of the controls.

Some foods have been shown to be deleterious to virus, i.e. cranberry sauce and orange juice, because of high acidity *(5)*, and cole slaw, possibly due to sodium bisulfite *(10)*. Lettuce and its water extract were apparently non-inhibitory for coxsackievirus B5.

Water did not efficiently remove virus from lettuce under experimental conditions where virus was applied in a buffered salt solution. It would appear that some binding occurred between virus and lettuce surface. This cohesion was reversed by a wash with PBS containing 1% serum at pH 8 but not with water. Since natural virus contamination of lettuce probably contain salts, it may be assumed that routine water washing of lettuce leaves might leave some virus behind. Stringent sanitary controls in the production and distribution of lettuce are therefore important.

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THE PROCESS CHEESE INDUSTRY IN THE UNITED STATES: A REVIEW[1, 2]

I. INDUSTRIAL GROWTH AND PROBLEMS

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ABSTRACT

The process cheese industry of the United States began over 55 years ago. Basic patents describing blending and heating and use of emulsifiers were the first, shared by Kraft and Phenix interests. In the early years a few competitors were licensed. Some dealers and cheese makers believed processing could ruin the cheese industry, but cheese consumption per capita increased. About 60% of consumers preferred process to natural cheese. Investigations of early practices led to definitions at state and federal levels; these have been re-defined and frequently revised. Demands of processors have affected the natural cheese industry in developing and locating new factories and aiding in composition and quality control. Processors promoted packaging and mechandising of all cheese. Cheese processors, associated dealers, and distributors organized the National Cheese Institute which has been a force in meeting problems of research, education, and regulation. From 1944 to 1968 it gave over $225,000 for independent research on problems of public health and industrial practices. The industry defended its trading practices in New York, Illinois, and Wisconsin with mixed success when accused of conspiracy to fix prices by the Federal Trade Commission in the 1940s, but today is largely responsible for orderly trading on the Wisconsin Cheese Exchange. Values established are important factors in Federal Milk Marketing orders which determine prices of fluid milk.

Process cheese manufacturing in the United States began over 55 years ago. Since then it has revolutionized the merchandising, distribution, and uses of cheese. It has increased the use of cheese. It has had profound effects on the manufacturing process of natural cheese. It has improved the economic strength of the cheese industry. Through the National Cheese Institute, which was founded by processors of cheese, it has influenced the form of definitions and standards and government relations and regulations at state and national levels. It has encouraged and financed research for the general benefit of the cheese industry and the public good. Members of the processing industry have been active participants in the Wisconsin Cheese Exchange, where orderly marketing of the nation's cheese has indicated values accepted in formulas for pricing milk under Federal Milk Marketing Orders.

Development of process cheese in the United States came at an opportune time for the cheese industry. Demand for cheese for export had ended with World War. I. Overproduction handicapped the industry. Cheese quality was low. Farmers were discouraged, even to the point of saying they were keeping cows only for the benefit of the soil.

This review is limited to development and research in the United States. Broad aspects of the historical and continuing technical and scientific research of Europe and other countries are available elsewhere *(87, 120, 149, 150, 159, 217)*.

Sources of information for this review include patents, bulletins, government documents, scientific journals, and recollections of men who have been, or are, active in the industry. Over 500 relevant items in trade papers have been examined; they include trade notices, news stories, discussions, editorials, letters, and advertisements. It is obviously impractical to include all such items in the bibliography, but publications rich in such background material are the *New York Produce Review and American Creamery* of New York City, *National Butter and Cheese Journal* and related papers of the Olson Publishing Company of Milwaukee, Wisconsin, *The Cheese Reporter* of Sheboygan Falls, but now Madison, Wisconsin, and *The Dairy Record*, St. Paul, Minnesota.

UNITED STATES ORIGINS

James L. Kraft strongly influenced the course of early developments in the process cheese industry in the United States. He was born about 1875 on a farm near Fort Erie, Ontario, and grew up in a family of 11 children with the religious background and training of his Mennonite parents *(46)*. In 1903 he started peddling cheese to stores in Chicago. He had a horse and wagon and capital of $65. The rapid development of the Kraft name and fortune in the cheese industry can be attributed to the organizing genius and business acumen of J. L. Kraft and

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[1]A contribution fom the College of Agricultural and Life Sciences, University of Wisconsin-Madison, Madison, Wisconsin 53706.

[2]The first part of a two-part review that will be published in this Journal. References cited in this part will be listed at the end of the second part of the review.

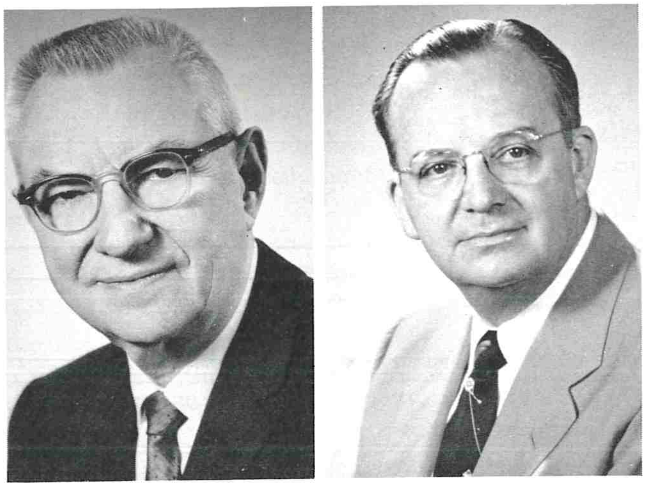

Figure 1. The authors; Walter V. Price, left, and Merlin G. Bush.

Figure 2. James L. Kaft with his cheese "wagon" and horse, Paddy, about 1903. (Courtesy of Kraft Foods Co.)

his brothers. From his small beginning in 1903 he developed his cheese business until, with two brothers, he first organized, in 1909, the company which has carried the Kraft name ever since.

In 1912 James L. Kraft began experimenting with blending and heating cheese *(129)*. By 1916 he was selling Cheddar cheese in 4-oz. cans. This cheese had been heated before and after canning. Large amounts were sold to the Federal Government for the armed forces. In June 1916 he obtained a United States patent which described the blending and heating of cheese. This was the first of several patents issued to or controlled by J. L. Kraft before 1922. These patents covered the processes of heating, blending, packaging, and the use of 5% sodium phosphate to prevent fat separation during heating and sterilizing *(217)*.

Another important figure in the early development of process cheese manufacture in the United States was Elmer E. Eldredge. He was born and raised on a dairy farm at Sharon Springs, New York, graduated from Cornell University, and did research in bacteriology and chemistry at the University of Wisconsin and in the Bureau of Dairy Industry, Dairy Division of the Department of Agriculture, Washington, D. C. In 1915 he was hired by the Phenix Cheese Company and assigned by L. E. Carpenter to duplicate Gerber's Swiss Gruyere cheese which was being imported in 8-oz. cans from Switzerland. His analyses and experiments showed that by mixing and heating cheese with 2% sodium citrate he could duplicate the Swiss product.

In 1915 the Phenix Cheese Company filed a United States patent in Eldredge's name describing the uses of citrate with American, Swiss, and Camembert cheese. The examiner insisted that only one type of cheese should be included. This delayed action on the patent for about 10 months during which time J. L. Kraft filed his patent application for blending and heating cheese. An interference case between the claims was settled in the examiner's office and the Kraft application was allowed and issued in June 1916; the Eldredge patent, assigned to the Phenix Cheese Company, was not issued until April 1921, but in the meantime the two companies had agreed to share their patent rights.

In 1921 other important patents not limited to

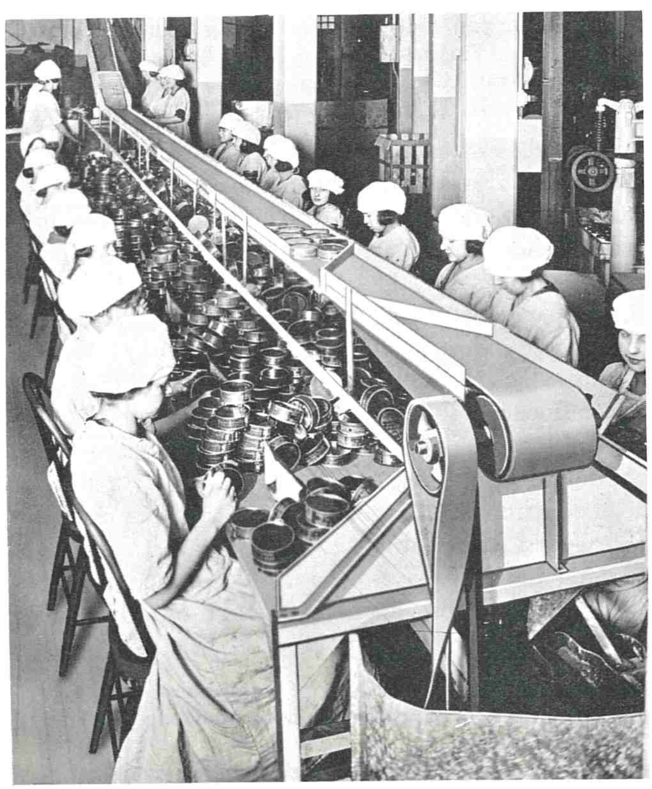

Figure 3. Attaching keys to cans of process cheese for the armed forces in 1918. (Courtesy of Kraft Foods Co.)

Figure 4. Boxing 4-oz. cans of process cheese for the armed forces in 1918. (Courtesy of Kraft Foods Co.)

Cheddar were granted to Elmer E. Eldredge and L. E. Carpenter of Phenix Cheese Company; these described the use of 2% disodium phosphate in processing *(55, 67, 217)*. Eldredge later carried on research and development work in the cheese field for Pabst Cheese Company, Kraft, Wheeler, Lakeshire, and finally Borden Foods, Cheese Division before he retired in 1955.

The knowledge gained in their development work and the patents granted the two companies established J. L. Kraft and Brothers Co. and the Phenix Cheese Corporation as the first manufacturers of process cheese in the United States.

J. L. Kraft and two of his brothers had incorporated in 1917 as J. L. Kraft and Brothers Co. with a capitalization of $150,000; their gross sales amounted to $2,000,000. By 1920 all six of his brothers were involved in the highly successful manufacturing and sales organization *(9)*. By 1923 J. L. Kraft and Brothers Co. had headquarters in Chicago and other operations in New York, San Francisco, Montreal, Pittsburgh, and in Plymouth and Brodhead, Wisconsin. Sales at that time had reached over $22 million. United States operations alone handled 60 million pounds of cheese of which 23 million were in the form of the new 5-lb loaf.

Early Producers and Patent Conflicts

The phenomenal success and growth of the process cheese business experienced by the owners of the original patents encouraged others to engage in manufacturing and merchandising. Between 1921 and 1928 such manufacturers included: The Great Atlantic and Pacific Tea Company, Cuba, New York; Lakeshire Cheese Company, Plymouth, Wisconsin; Pabst Corporation, Milwaukee, Wisconsin; Ladysmith Cheese Company, Chicago; Ackerman and Emmenegger, Monroe, Wisconsin; Lowville Cheese Company, Lowville, New York; Brodhead Cheese and Cold Storage Company, Brodhead, Wisconsin; Wis-

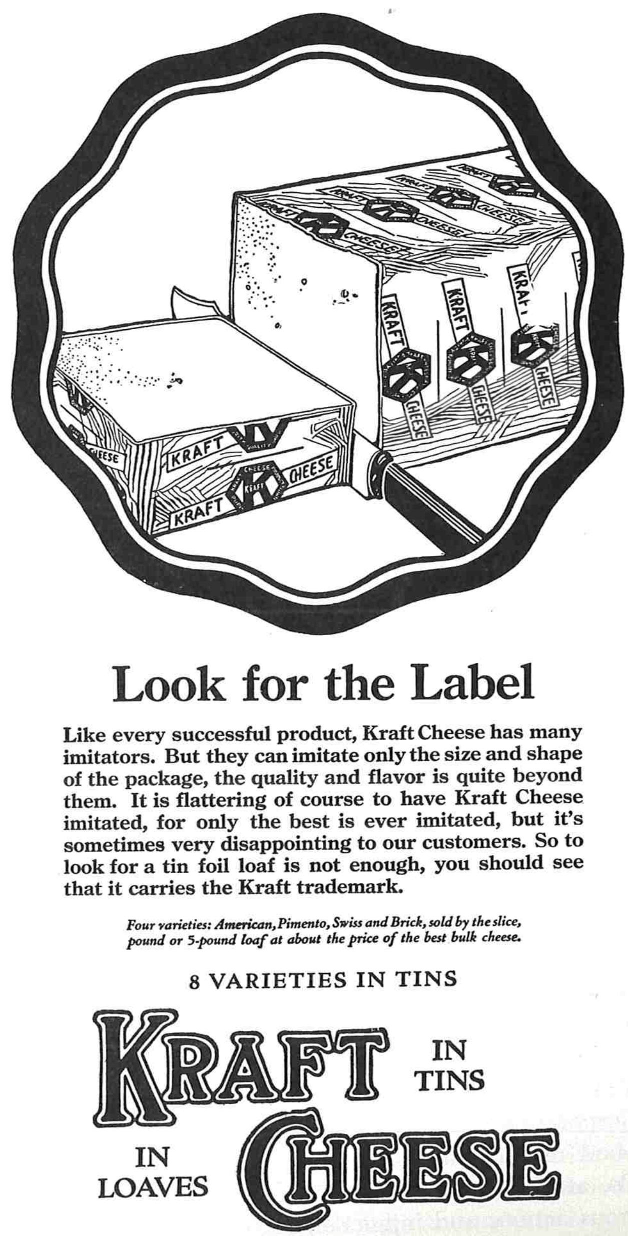

Figure 5. Early advertising of process cheese in tins and loaves, about 1921. (Courtesy of Kraft Foods Co.)

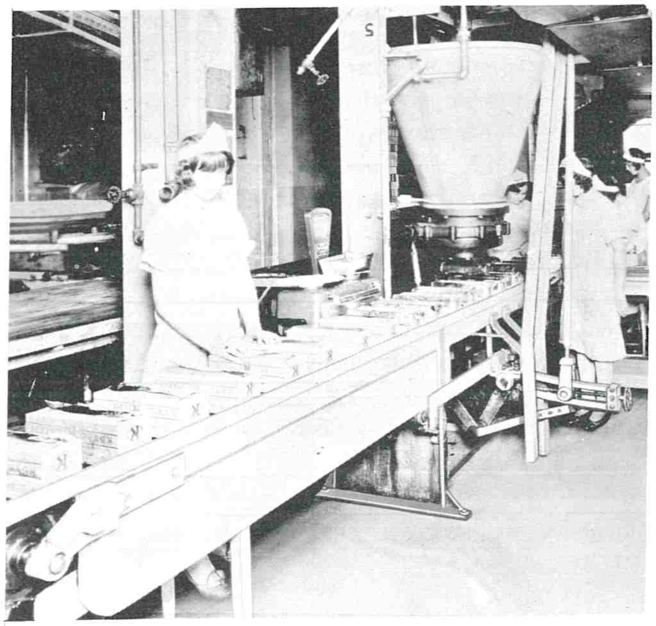

Figure 6. Filling 5-lb. wooden boxes and folding down tinfoil before nailing on covers, circa 1925. (Courtesy of Kraft Foods Co.)

consin Cheese Corporation, Monroe, Wisconsin; F. X. Baumert Cheese Co., and Hasselbach Cheese Co. of Buffalo, New York; Swift and Co., and Armour and Company, Chicago; and Shefford Cheese Company, Syracuse, New York. Patent infringement suits were brought against one after another of these manufacturers by the patent owners.

The first decisive court action by J. L. Kraft and Brothers Co. was against the Pabst Corporation in 1925. Judge F. A. Geiger of the Eastern District Court of Wisconsin rendered a decision in 1927 which sustained the patents covering sterilization, pasteurizing, and packaging. Pabst continued to operate under a licensing agreement and eventually became a subsidiary of the Kraft interests as the Pabst-ett Corporation.

Cases were pending in March 1927 against Swift and Shefford, but companies not affected were Phenix, Lakeshire Cheese Company, F. X. Baumert, and certain large packers. In May 1927 suit was filed in U. S. District Court by Kraft against Ladysmith Cheese Company of Chicago asking for an accounting of profits realized, for a judgment for damages to profits sustained by Kraft, and for court costs. Other manufacturers, like the new Wisconsin Cheese Corporation of Monroe, Wisconsin, makers of "Dutch Maid" brand, and the Great Atlantic and Pacific Tea Co. at Cuba, New York, when faced with such vigorous actions and injunctions, stopped manufacturing. A limited number of licenses were granted to operate under the patents. The essential patents expired in 1938 after the usual 17 years of control.

During this interval of protection by the original patents, Kraft and Phenix prospered. In 1928 the two companies merged to form the Kraft-Phenix Cheese Corporation with J. S. Whitney as the first president. Some of its success must be attributed to the company's advanced programs of motivating employees and sales personnel. Special insurance benefits were developed. House organs were used effectively to stimulate interest in the company, its products and progress. Eventually the same educational activities were extended to dairymen supplying Kraft-Phenix factories. Youth and adult educational and incentive programs were carried by company representatives to southern and western states. J. L. Kraft predicted that Idaho could become the next leader in cheese production. The success of cheese manufacturing operations in southern states, when pasteurization of milk for cheese became universal, convinced Kraft that cheese could be made successfully in any area where dairying was possible. This was an uncommon belief in the 1920s.

By 1931 Kraft-Phenix had plants in 30 states as well as Canada, Australia, Cuba, and England. By 1934 more plants were located in Germany, Holland, France, and the Argentine. The company employed 10,000 people and sold 1,000,000 lb. of cheese per day. At about this time the Kraft-Phenix Cheese Corporation was absorbed by National Dairy Prod-

Figure 7. Treating Swiss and Gruyere with granite rollers before cooking, circa 1940, Monroe, Wis. (Courtesy of Borden Foods, Cheese Division, Borden Co.)

ucts Corporation (now Kraftco Corporation), but objectives, projects, and methods of the company remained essentially the same. The Corporation moved from its old quarters on Rush Street, Chicago, to its modern 9-story building on Peshtigo Court, Chicago, which became the international headquarters for the Kraft-Phenix organization.

OPINIONS AND REACTIONS TO PROCESS CHEESE

The amazing growth of process cheese production after it was introduced in 1919 aroused strong reactions and some animosity. The reactions were typically expressed by F. Grunert, a Chicago cheese dealer, who told the Chicago Wholesale Cheese Dealers Association in December 1922 that the product was a menace to the cheese industry. He stated that it was inferior in food value and quality, low in fat, high in moisture, contained defective cheese, foreign fat, skim milk cheese, and sodium benzoate. He argued that it was not pure cheese, was overpriced, likened it to renovated butter, and said it should be regulated to protect the public from "arrogant" manufacturers, monopoly, and deception *(8)*.

The Phenix Cheese Corporation and J. L. Kraft Brothers Co. promptly denied the charges of Grunert. J. L. Kraft in a letter of rebuttal accused Grunert of prejudice, ignorance, and intent to "besmirch" the new product *(132)*. Kraft went on to describe the manufacturing process and argued that pasteurization was a desirable health protective measure. He pointed out that the process did not destroy cheese flavors, nor disguise defective body. He said that government inspection of product and processes was wholly acceptable. He declared that the process so improved the keeping quality that the product could be sold in hot or cold climates. Finally, he denied as "impossible" the accusation that the processors could control the industry. Kraft submitted as evidence of his faith in the industry and goodwill, his plan to spend $250,000 in 1923 to promote the value of all cheese. This plan was possible, he indicated, because of the wide acceptance of process cheese.

The belief that sales of process cheese hurt sales of natural cheese was expressed by some dealers, farmers, and cheese makers, and was echoed by some editors and politicians. They called it "embalmed," "imitation," "spurious," "moonshine," "madeover," and "renovated." They wanted laws to protect the consumer against "deception." Politicians were asked to sponsor legislation to control production. Some of them promptly exploited such antagonism and ridiculed and belittled the product in attempts to win favor and votes. These attitudes persisted long after regulations to protect the consumer had been adopted. Even as late as 1958 they were expressed by Wisconsin Governor-Elect Gaylord Nelson, speaking to members of the Wisconsin Cheese Makers Association in Madison, Wisconsin and referring to process cheese as "processed rubber that ought not to be served any place or any time *(21)*.

In the late 1920s there were many other strong, varied, and more reasonable opinions developed about processed cheese and its effects on the industry and the consumer. Some people were concerned that production was keeping prices too high for maximum consumption. Actually per capita consumption of all cheese had begun to rise slowly by 1923 and natural cheese production was increasing faster than the production of butter *(10, 11)*.

Some feared that the new packaged product was reducing sales of natural cheese because retailers preferred the keeping quality, convenience of handling bundles of 5-lb. loaves, and the lower cutting losses. Others agreed with this opinion but explained that although some sales of natural cheese were lost, the total effect was to increase sales of all cheese. Many cheese makers recognized the appeal of the 5-lb. loaf and believed that it actually stimulated their own sales of natural cheese in both 5-lb. loaves and miniature styles *(11)*.

J. A. Ruddick of the Canada Department of Agriculture in 1925 observed that the new product was the best thing in years for the cheese industry because it opened new markets and increased market prices. He said that it stimulated trade in Great Britain and cited imports at the Port of Manchester as an example, where receipts in March 1923 increased from 3,150 25-lb. bundles of processed loaf to 127,202 bundles in March 1925. Cheddar receipts at the same port increased only 13% over the same period.

It was not until 1932 that a noncommercial study was made by Hobson and Schaars at the University of Wisconsin to determine consumer preferences for cheese by types and quality without introducing such factors as costs, availability, convenience, or keeping quality. They used two methods of getting reactions *(112)*. In stores in Wisconsin, Georgia, North Carolina, Ohio, and Pennsylvania, 2,112 customers were given unidentified samples of natural and processed cheese and asked tc make a choice. At meetings of farm people in Wisconsin, the same technique was used in contacting 1,137 people. About two-thirds of all the people preferred processed cheese. Giving people different, unidentified kinds and qualities of cheese during regular meals over extended periods showed that processed cheese was consumed in larger amounts than natural cheese.

These results showed strong preferences for processed cheese, but they also showed that the large minority which preferred natural cheese constituted an important segment of the market for cheese.

The results of this study by Hobson and Schaars pleased process cheese manufacturers and merchandisers, but it also aroused criticisms like those expressed by Wisconsin Senator Morley Kelly *(128)*. In a letter to Dean Chris L. Christensen, University of Wisconsin College of Agriculture, he declared that ". . . the College could spend its time and money to better advantage than get out advertising that the grinders couldn't buy for millions." He stated that such "worthless facts and figures" made farmers "subservient to the Bordens, National Dairy, Kraft, and other foreign subsidiaries." Such hostile expressions were common in Wisconsin from the early 1920s to the 1950s. The fact that they were often expressed by men in public office undoubtedly influenced the conclusions of manufacturers, who were considering the merits of establishing or expanding facilities either in Wisconsin or elsewhere. Some operations were moved out of Wisconsin.

DEFINITIONS AND STANDARDS

By 1925 the charges of alleged adulteration caused the Wisconsin legislature to order an investigation. J. Q. Emery, Wisconsin Dairy and Food Commissioner, assigned Axel T. Bruhn, Chief of the Cheese Division, and J. E. Boettcher, Chief of the Butter Division, to make this investigation of manufacturers. Dr. H. H. Sweitzer, Federal Bureau of Chemistry, accompanied the Wisconsin officers. Beginning in October 1925, these men inspected the 8 plants making process cheese in Wisconsin *(71)*. These included Wisconsin plants of Kraft, Phenix, and Brookshire at Plymouth; Sheboygan Dairy Products and American Cheese in Sheboygan; Pabst, Milwaukee; C. A. Straubel, Green Bay; and Ackerman and Emmenegger, Monroe. The inspectors observed sanitation, products manufactured, raw materials, preparation of cheese, ingredients-not-cheese, mixing of varieties, methods of heating, and size and labeling of packages.

The report of these inspectors was informative and not unreasonably critical. They described sanitary conditions for the several plants, for example, as "kept reasonably clean," "arrangement . . . could be improved . . .," "might be operated more easily under sanitary conditions . . ." and "using well-designed equipment."

All plants, according to this report, were trying to make process cheese uniform in quality and better in keeping quality than natural cheese. The inspectors noted the blending of American cheese with Swiss to be sold as "Process Swiss Loaf," and the resulting odds and ends and faulty lots of process being made into Pimiento. They found no milk powder, whey albumin, butter, or skim milk cheese being used, although some plants admitted they had previously used one or more of these products. Sugar was being added to some batches. Emulsifiers used were C. C. salt, i.e. Rochelle salt (sodium-potassium tartrate), sodium citrate, and disodium phosphate. One operator indicated that emulsifiers were unnecessary when correct blends of cheese of the right age and quality were used. The inspectors could not understand the uniformly low fat, 49.6% in the dry matter, when most Wisconsin cheese contained 52 or 53% fat in the dry matter.

The Emery report disclosed that in response to a formal request from a manufacturer in 1921, the commissioner had ruled that process cheese made with butter or skim milk cheese was not American cheese even though it conformed in fat and moisture content to the Wisconsin standards. He said that such cheese should be called a compound. In 1922 he told the manufacturer he would have to contest the legality of a product when it contained substances other than the cheese it purported to be.

The 1925 Wisconsin Legislature used Emery's investigation *(71)* to define process cheese. This definition of process cheese provided for mixing and blending, with the aid of heat, cheese of different lots, flavors, ages, and composition to make the product in the desired quality and shape. It permitted the use of seasoning, color, and not over 3% harmless emulsifier. Amounts of moisture and fat followed then existing definitions of varieties with a 1% tolerance in moisture. The definition did not permit use of curd, skim milk cheese, or blending of varieties. This conformed with the ruling of Emery in 1921 which stated that the use of such products violated the right of the public ". . . to be truthfully informed . . ." This definition set the essential pattern for subsequent state and federal standards.

It became clear immediately that unless similar definitions were promulgated by the Federal government, some processors, especially those with manufacturing facilities in other states, might choose to leave Wisconsin. Emery and his chief chemist, Harry Kleuter, presented arguments for a descriptive name and definition to the National Joint Committee on Definitions and Standards in Weshington, D. C. on January 18, 1926.

The name of the product continued to be a problem. "Pasteurized Process Cheese" received favorable attention. In December 1926 the Federal Standards Committee of the Bureau of Chemistry, U.S.D.A., proposed a definition which stated that process cheese, meaning process Cheddar and process American, should conform to Cheddar standards; however, process with a varietal name should conform to the standards of that variety. The Wisconsin Cheese Makers Association, at its annual meeting in February 1927, endorsed this definition and pleaded for strict enforcement to regulate traffic in process cheese with its "deplorable" ills.

At a hearing before the Federal Food Standards Committee in March 1927 the National Cheese Institute, through its legal counsel, Senator Lenroot, joined with process cheese manufacturers Phenix, Kraft, Lakeshire, and Pabst to approve the proposed standard of December 1926. They suggested that the cheese be called "pasteurized-blended" cheese. They also presented reasons for including 0.3 to 3% emulsifier and a 1% tolerance in moisture to control quality and prevent cracks and granulation.

Legal controls of process cheese have been a continuing concern for industry as well as consumers. Beginning in early 1947 definitions and standards of process cheese and its modifications were further modernized by public hearings. These hearings were called by the Food and Drug Administration to consider amendments of existing regulations for cheese, process cheese, cheese foods, cheese spreads, and related foods. All hearings were held in Washington, D. C. and were attended by manufacturers and representatives of interested or related industries, by the National Cheese Institute, and representatives of regulatory agencies of several states, the United States Department of Agriculture, the Food and Drug Administration, and consumer groups. These people were asked to present their suggestions and supporting evidence to justify amendments or changes in names, classification, composition, ingredients, methods of manufacture, and labeling of the products under consideration. The essential purpose of these meetings, which continued intermittently until 1950, were intended to promote honesty and fair dealing in the interests of consumers.

The cheese industry did not present a united front at the hearings. All was not "sweetness and light." One controversial proposal, for example, was Kraft's request that any process cheese item other than American, Swiss, Pimiento, and Brick be limited to a 2-lb. size. They argued that this would avoid confusion, but opponents defeated the proposal with the argument that size limitation was not an acceptable method for defining a food product.

Importers of foreign cheese tried to prevent the use of European names such as Emmenthaler, Gruyere, Roquefort, Muenster, etc., but did not object to the name Cheddar. The domestic industry generally attacked this proposal as being self serving. Later some of these names were, of course, limited by other laws.

The findings of facts and definitions developed during these hearings were published in 1950 *(81)*. Is is unnecessary to describe these definitions in detail, but it is remarkable to note how closely they resemble the principles of the definitions of the Wisconsin legislature in 1925 and those of the Federal Standards Committee, United States Department of Agriculture, Bureau of Chemistry in December 1926.

The provisions of the 1950 standards indicate the extent and nature of changes in the phenomenal growth of the industry since 1920. The name "pasteurized process cheese" is used to describe the food made by grinding and mixing one or more varieties of cheese with added emulsifying agents, water, salt, and color, and heating the mixture to make the pasteurized product of desired texture and composition. A similar food made without the emulsifying agents is called "pasteurized blended cheese." The list of emulsifying agents is extended over previous definitions to include phosphates of higher molecular weights and certain potassium and calcium salts. Moisture and fat limitations are made flexible to allow blending of different varieties of cheese. Approved acidifying agents are listed and are restricted by limitations on the pH of the finished product. New sections are devoted to definitions of pasteurized process cheese foods and spreads to indicate differences in fat and moisture and other modifications to achieve softer consistency and spreading properties. Included also are provisions for incorporating fruits, vegetables, and meats in all products. Specific requirements are listed for labeling to show nature and composition of each product.

These definitions became effective 6 months after their publication on August 24, 1950. They have been amended many times to permit improvements, and they are still undergoing changes as needs arise from time to time *(81)*.

EFFECT OF PROCESS CHEESE ON THE CHEESE INDUSTRY

Development of process cheese affected directly every phase of the production and merchandising of cheese.

Quality and grading

Process cheese manufacturers first bought cheese from dealers on the open market. When some began to buy cheese directly from factories, competition for preferred factories was keen. Many of the antagonisms toward the process cheese industry began with this competition for natural cheese.

The process cheese industry was accused of providing an outlet for cheese of inferior quality. This accusation, while true in part, did not apply only to processors. Cheese with some defects in quality, like some volatile odors, could be accepted by processors because they disappeared in the processing treatment. Some minor defects could be diluted to extinction by blending.

In the early 1920s, the Swiss cheese industry in the United States was struggling to meet the competition of the carefully selected imports. Eye formation was the criterion of value and cheese with eye defects was a drug on the retail market. But unless accompanied by other over-riding faults, Swiss cheese with less than ideal eye formation could be processed successfully. By 1923, the Kraft organization alone was moving 600,000 to 700,000 lb. of Swiss cheese of all grades per month *(7)*.

The cheese industry of Wisconsin was especially involved in the controversy over process cheese and the cheese quality issue. Cheese makers and dealer-distributors as well as processors recognized the risks of accepting inferior products either for processing or for sale as original cheese. Identification of quality by official grading was advocated to promote orderly marketing. Wisconsin adopted a compulsory grading program in the early 1920s. At about the same time the United States Department of Agriculture defined American cheese grades for voluntary use.

Market recognition of the low grades did not involve enough regular trading on the Exchange to establish price differentials. Actually the percentage of State Brand cheese in Wisconsin usually included over 90% of annual production. It soon became apparent that some of the original cheese of No. 2 grade was being routed to markets which accepted, or even preferred, such defects as openness or acidy flavor. In the same way some of the No. 2 grade was processed without detracting from the quality of the finished product. The remaining cheese, with defects too extreme to use in such ways, was moved into outlets other than human food. The characteristics of the cheese, not the grades, have always determined the destination of the cheese.

Milk quality

Buyers of cheese for processing were among the most aggressive advocates of milk quality improvement in factories. Their representatives, acting as fieldmen and advisers, were especially effective as they called frequently and established a direct contact between the maker and his market outlet.

Sediment tests by fieldmen were especially important because extraneous matter removed by filtration could be evaluated, identified, and classified by sources *(81, 161)*. This insoluble material in the milk and cheese was used by regulatory agencies to police conditions of production. The National Cheese Institute appropriated funds to research laboratories and educational institutions to study methods of detecting and controlling extraneous matter in milk and cheese. In 1949 the Food and Drug Administration issued a standard guarantee form and told all purchasers that they would be well advised to have such a guarantee form signed by every supplier, and that such guarantee would automatically transfer liability for extraneous matter or other quality defects to the supplier and away from the purchaser.

Pasteurization

Processors of cheese became the chief industrial advocates of pasteurization of milk for cheese making in the late 1920s as they turned to southern states for cheese supplies. Processors like Kraft, Swift, Armour, and Cudahy were among the first to promote cheese making in the south, aided by introductory work of the Bureau of Dairy Industry, U.S.D.A. and state extension workers. Communities were offered free advice, liberal financing, aid in starting manufacturing operations, and contracts for the cheese produced.

Factories in New York, Wisconsin, and some other northern states resisted the trend toward pasteurization for another 20 years. Their reluctance was understandable because dealers demanded raw-milk cheese to which their trade was accustomed. Some, but not all, processors favored the rapid ripening and high flavors of raw-milk cheese.

As factories in northern states increased in size, during and immediately after World War II, pasteurization of milk for cheese was accepted, although reluctantly, by more processors, older makers, and dealers. Makers were encouraged to use substandard temperatures and times of holding to obtain some advantages of pasteurization. Such treatments gave more rapid curing, but entailed some obvious disadvantages and hazards.

Food intoxication caused by *Staphylococcus aureus* in cheese *(160)* and outbreaks of typhoid traced to raw-milk cheese *(191)* showed the desirability of strict pasteurization for fresh unripened cheese. The Federal definitions and standards recognized the safety of using raw-milk cheese in processing by defining a cheese "for manufacturing" which could be shipped in interstate commerce for processing without holding 60 days at 35 F and without being phosphatase-negative.

A secondary effect of pasteurization was the need for larger factories and new buildings. During this period of expansion of factory facilities, engineers were involved in plant design and construction. Some of these modern designs explained the engineering and operational advantages of dry floors, isolation of pasteurizing and separating from make room activities, use of milk holding tanks, isolation of starter room facilities, and flow of products through the

TABLE 1. PAST PRESIDENTS OF THE NATIONAL CHEESE INSTITUTE

Year elected	Years in office	President	Year elected	Years in office	President
1927	1	J. H. Wheeler	1953	2	L. E. Cahill
1928	4	O. H. Limpus	1955	2	W. H. Pauly
1932	6	Wm. F. Hubert	1957	2	J. J. Gaffney
1938	1	W. F. Jackson	1959	2	V. R. Butler
1939	2	J. H. Wheeler	1961	2	M. G. Bush
1941	3	J. H. Kraft	1963	2	A. L. Williams
1944	1	L. G. Butler	1965	2	C. E. Geppinger
1945	2	H. I. Hoffman	1967	1	Peter Frigo
1947	1	D. A. Meeks	1968	1	Ed Trier
1948	1	L. D. Schreiber	1969	1	Frank Klensch
1949	2	W. J. Wilson	1970	1	Edwin Rufenacht
1951	2	A. W. Sigmund	1971	2	D. D. Nusbaum

TABLE 2. GRANTS IN AID OF RESEARCH PROJECTS BY THE NATIONAL CHEESE INSTITUTE

Years	Institutions and grants	Projects
1944-48	Univ. of Wisconsin $11,725	Sampling and analyzing cheese
1946-48	Cornell Univ. $11,000	Inducing higher flavor formation and the survival of certain pathogens in pasteurized milk cheese.
1947-49	Univ. Wisconsin $10,800	Chemistry and bacteriology of ripening raw and pasteurized-milk cheese.
1948-49	Univ. Chicago $3,500	Effects of certain strains of streptococci on cheese. (The role of cheese in food poisoning by alpha-type streptococci.)
1949-53	Univ. Chicago $12,500	Staphylococcus food poisoning study.
1951-56	Univ. Chicago $141,000	*Clostridium botulinum*
1956-58	Univ. Wisconsin $10,000	Hydrogen peroxide-catalase
1967-68	Univ. of Wisconsin $18,200	*Salmonella* during manufacturing and ripening of cheese.
1968	Univ. Minnesota $7,500	Some factors influencing growth and enterotoxin production by *S. aureus* during cheese making.

plant from receiving to shipping *(23)*. Processors were deeply involved in manufacturing, and this trend is continuing today.

Composition and premiums

Processors were faced with problems of moisture and fat control to meet legal standards. About 1920, processing was done first in steam jacketed kettles. Eventually heating was done more efficiently and rapidly by injecting live steam into the cheese while stirring in the cooker. This procedure also made a greatly improved product. The condensed steam, however, increased the moisture in the finished product, and processors, to meet this problem, offered a premium for low-moisture cheese. The reference point adopted for premium payments was 61% dry matter. The market price per pound of Cheddar divided by 61% gave the basic value of 1 lb. of dry matter (cheese solids). The cheese with more than 61% dry matter was paid for proportionately. This compensated for lower yield. This practice of trading on the moisture basis had the desired result and indirectly encouraged use of more salt, improved quality, and prolonged the curing and storage life of the cheese.

Factories which did not sell on the moisture basis began to specialize in making small styles of cheese, like daisies, longhorns, and midgets, with maximum moisture for consumer acceptance. These styles commanded a premium. The 75-lb. Cheddar style was made almost exclusively for processing purposes. Larger styles were made to reduce trimming losses and eventually in the 1950s the packing of curd in barrels holding about 500 lb. was widely adopted and is now standard practice. Prices were reported on sales of barrel cheese on the Wisconsin Cheese Exchange beginning April 29, 1960.

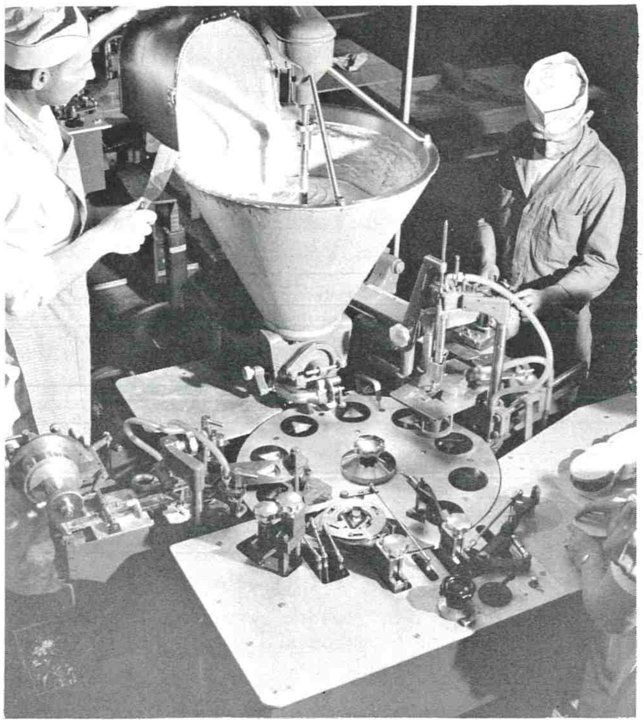

Figure 8. Packaging Gruyere cheese in individual-size units, circa 1940, Monroe, Wis. (Courtesy of Borden Foods, Cheese Division, The Borden Co.)

Standardization of milk fat to increase yields of Cheddar cheese per pound of milk fat was used in southern states or where high-fat breeds prevailed. In areas like Wisconsin, where fat in cheese milk commonly averaged about 3.65%, the need for fat adjustment was not so necessary; it was actually illegal in some states, including Wisconsin, until after World War II. Cheese made from nonstandardized milk averaged about 52.5% fat in the dry matter (FDM) except in late spring. Processed cheese made with blends of Cheddar cheese, emulsifiers and salt contained the 50% FDM required by law.

It was natural that makers of cheese should demand the right to adjust the composition of milk to incorporate less fat in the dry matter and so obtain a higher yield per pound of fat. Advocates and opponents of standardization debated merits of methods of compensating factories for milk fat exceeding 50% FDM *(57, 75, 185)*. Some processors soon offered a premium for fat in excess of 51 to 52% FDM. This premium was offered only for cheese used in processing and was paid in addition to the premium for low moisture. One table of premiums for FDM over 52% appeared in 1947 without identification of origin. The excess fat was valued according to the price of 92-score butter on the Chicago market. The premium increased per unit of excess fat as butter prices increased but not in proportion to the increase in the price of butter.

Another table in use since 1952 offers a flat $0.00025 per pound of cheese for each 0.1% FDM in excess of 51% and up to 55%. This table shows no adjustment for changing butter prices probably because government support prices have been relatively constant.

There has been no uniform attitude in the processing industry concerning premiums for excess fat. Policies varied according to the area of manufacturing and the standardizing practices of factories.

In July 1966, U.S.D.A. began increasing support prices of cheese faster than prices of butter, so that in 1972, the advantages of removing fat or adding nonfat dry milk to standardize milk for Cheddar used for processing were practically negligible. The cost of fat in cream used to increase fat in the dry matter by 1% in processed cheese approximates $0.0007 per lb. of cheese. With original cheese at $0.485 per lb. and 80% cream at $0.69 per lb., it is obvious that the processor today can scarcely justify the premiums previously offered for cheese with over 52% FDM. Likewise, the cheese maker cannot afford to remove cream because its value as cream does not compensate for the decreased yield when it is removed. Neither can the adjustment be made profitable by adding nonfat dry milk at current prices because its cost alone would exceed the increase in yield of cheese.

Procurement

Competition for regular sources of cheese for processing and natural cheese sales was keen from the early days of the process industry. Each outlet had special needs. Preferred factories willing to make cheese by specified methods to produce certain styles, sizes, or with special equipment, or milk treatments, bargained for special contracts. Such contracts varied widely and consisted of premiums over current prices on the Wisconsin Cheese Exchange. Special inducements included free supplies like bandages, boxes, salt, color, barrels, and hauling between factories and warehouses *(162)*. Processors in recent years have provided aids in starter management, supervision of factory operations, aid in manufacturing problems, and even advice in plant design and construction. Efficient factories, especially those with large output, skilled management and labor, modern equipment, and sanitary practices, were favored and have prospered. Some processors own and operate their own cheese factories.

Distribution

First wagons and then trucks, which were still called "wagons," distributed process cheese from store to store. The practice was, and still is, highly effective. These wagons were usually owned, controlled, or licensed by the processor or his distributor. Each driver was instructed how best to aid the retailer by arranging displays of processed cheese and colorful posters to stimulate interest and sales. They emphasized eye appeal, methods of serving, brand names, and convenience. Retailers approved, but competitors complained, correctly, that such services minimized their position in the display case or shelves.

As early as the late 1920s packaged process cheese was being accepted readily, instead of the natural, bulk cheese, both by customers and retailers; customers wanted packaged foods *(189)*. Inventories of process cheese in 1928 were larger than those of natural cheese *(86)*. Retailers began to refuse to handle bulk, natural cheese in the summer months because of spoilage, insect problems, and inferior quality. The new processed cheese in the foil-covered loaves was well established. Canned process cheese was available but was reserved for distribution in the tropics.

The natural cheese industry and processors, who are now important distributors of natural cheese, have joined with the Division of Markets of the Wisconsin Department of Agriculture and Markets in sponsoring the National Cheese Seminar. This annual seminar, which was held first in 1965, meets to study and evaluate methods of selling cheese in all parts of the United States. Experts in store management and merchandising join in these efforts to promote sales of cheese.

Packaging

In the 1920s processed cheese was introduced into a market which had a wide variety of small units of natural cheese. These units included Cheddar in the form of longhorns, prints, and the pineapple modification, as well as Brick, Muenster, Roquefort, Liederkranz, Limburger, and Camembert. One type was the popular Club cheese (cold pack) which was sold in small porcelain or glass jars and in 3-1/2 oz. foil-wrapped packages. Some of these small units were attractively soft. Processors soon developed softer types of pasteurized process cheese foods such as Pabst-ette, Nu-Kraft, and Phe-net made by Pabst, Kraft, and Phenix, respectively.

In 1924 another notable attempt to duplicate the process 5 lb. loaf was that of Charles and E. J. Pauly, as well as C. A. Straubel and Company. They made a rindless loaf by fusing a wrapper of foil with heat and pressure to the surface of the cheese. It was a limited success, especially in direct sales where long life was not essential. The Challenge Creamery of Modesto, California attempted to weld a foil wrapper to prints of cheese with a layer of process cheese.

Efforts to protect natural cheese for merchandising so it could compete with process in consumer units involved many other variations. These included canning of blocks, prints, and slices, packaging in carbon dioxide, use of antimycotics and perfection of moisture-proof, gas-tight wrapping materials. The most successful packages have made natural cheese almost as durable as process *(241)*.

All of these methods of packaging natural cheese are tributes to the success of the original 5-lb. loaf of pasteurized process cheese and its many modifications.

THE NATIONAL CHEESE INSTITUTE

The need for a national cheese industry organization was recognized in the early 1920s. W. E. Skinner, the manager of the National Dairy Show in Chicago in 1920 invited the men in industry to form such an organization without success.

The National Cheese Institute (NCI) was organized February 16, 1927 by process cheese manufacturers together with assemblers and distributors, and incorporated in 1927. It has developed as the only national association of the cheese industry. Its voting membership now includes those who manufacture cheese and process cheese, assemblers, distributors, and wholesalers of cheese and related products, including whey and its derivatives. Nonvoting associate members are persons or corporations whose interests and services are directly related to the industry. The members of the Institute make over half of all cheese produced in the United States, excluding cottage cheese, and they merchandise over 80% of all cheese sold in the United States.

The original constitution of the National Cheese Institute listed three classes of members: manufacturing processors; assemblers and distributors of their own brands of process cheese; and other cheese job-

Figure 9. Recipients of Past President Awards of the National Cheese Institute. From the left, seated: L. G. Butler, John H. Kraft, Harry I. Hoffman, and W. H. Pauly. From the left, standing: Peter Frigo, C. E. Geppinger, M. G. Bush, V. R. Butler, Frank Klensch, and A. J. Willems.

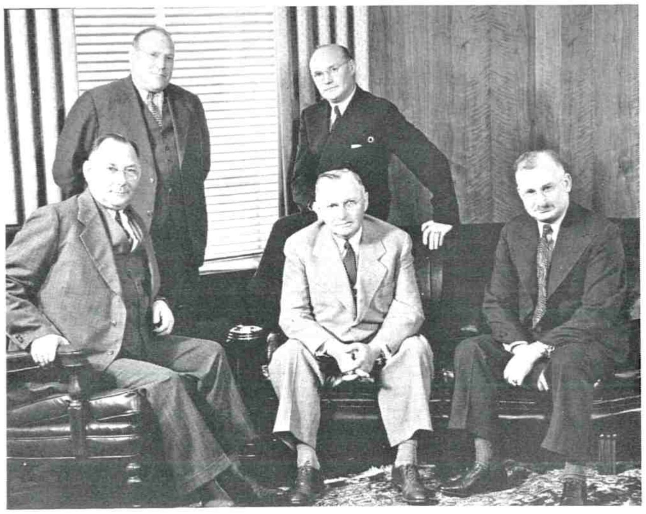

Figure 11. The Kraft brothers, circa 1940. From the left, seated: Charles H. Kraft, James L. Kraft (Founder), John H. Kraft; Standing; Norman Kraft, Fred Kraft. (Courtesy of Kraft Foods Co.)

bers and distributors. The first elected president was Harmon Wheeler of Lakeshire Cheese Co. and the first vice president was Fred Pabst of Pabst Cheese Corp. John D. Jones, Jr., a lawyer, was the first Executive Secretary, serving until 1931. He was succeeded by another lawyer, George L. Mooney, 1931 to 1942; by an economist, Dr. E. W. Gaumnitz, 1943 to 1968; and in 1968 by Robert F. Anderson, Dairy Technologist. Table 1 lists the presidents who have served the Institute.

The charter members of NCI were the processors: Lakeshire, Kraft, Swift, Armour, Ackerman and Emmeneger, Phenix, and Pabst. The assemblers and distributors were Winnebago Cheese Co., A. D. Deland Co., Pauly and Pauly, Schmitt Bros., C. E. Zuercher Co., Davis Bros. Cheese Co., J. S. Hoffman Co., R. Gerber and Co., C. E. Blodgett Cheese, Butter and Egg Co., Inc., John Kirkpatrick, Inc., and C. A. Carlson Co., Inc.

Objectives

The NCI was organized to provide a forum where members might meet to consider industry's problems and to develop policies and to take necessary actions for development and protection of the industry. News releases and communications for publication were issued in 1927 by the Executive Secretary to tell the public about process cheese, how it was made from natural cheese, blended and pasteurized for uniformity, safety, and keeping quality. The releases called attention to its convenience and emphasized its importance as an outlet for fine natural cheese, a fact disputed by some of its competitors.

In September 1927, the NCI for the first time spoke for the interests of its members at a public hearing in Wisconsin. A committee consisting of W. H. Patterson, H. G. Davis, and F. H. Pentlarge appeared with the Executive Secretary, John D. Jones, Jr., to explain the attitude of the Institute on a ruling of the Wisconsin Attorney General which had the effect of changing the definition of American Cheese. These early actions signaled the trend of NCI actions in the years that followed.

The policies of the Institute today are formulated by a Board of 21 directors selected by the membership at the annual meeting. The activation of these policies is the responsibility of an executive committee consisting of president, treasurer, and nine directors.

The numerous committees of the Institute indicate the scope of its interests and activities. In addition to the executive committee, there are committees on programs, bylaws, membership, publicity, labor, public relations, transportation, and research, as well as committees concerned with the common varieties of cheese.

The NCI routinely sends its members information originating in government and industrial activities, statistical data, and information on other matters of interest or concern. The Institute is the liaison agent which keeps members in touch with the Dairy Industry Committee, the Special Dairy Industry Board, the American Dairy Association, and the National Dairy Council.

The Institute follows closely the development and enactment of legislation at city, state, and federal levels which may affect the manufacture, sale, and distribution of cheese and cheese products. Such regulations may involve definitions and standards of cheese and cheese products, such as those developed, promulgated, and revised by the Food and Drug Administration in the United States, and the Codex Alimentarius in international trade. Other matters, concerning which members are kept informed, are import and export regulations and restrictions, tariffs, government support and procurement programs, labor problems, and similar developments. The NCI represents its members at state and regional meetings of scientific groups and organizations which may influence the industry through sales, education, merchandising, and research.

Research

The Directors of the NCI through the years have established the policy of encouraging research for the welfare of the industry. Table 2 lists grants and subjects of research at several institutions in recent years. These grants total over \$250,000. In addition, individual members of the Institute have allocated over \$200,000 to research projects, the benefits of

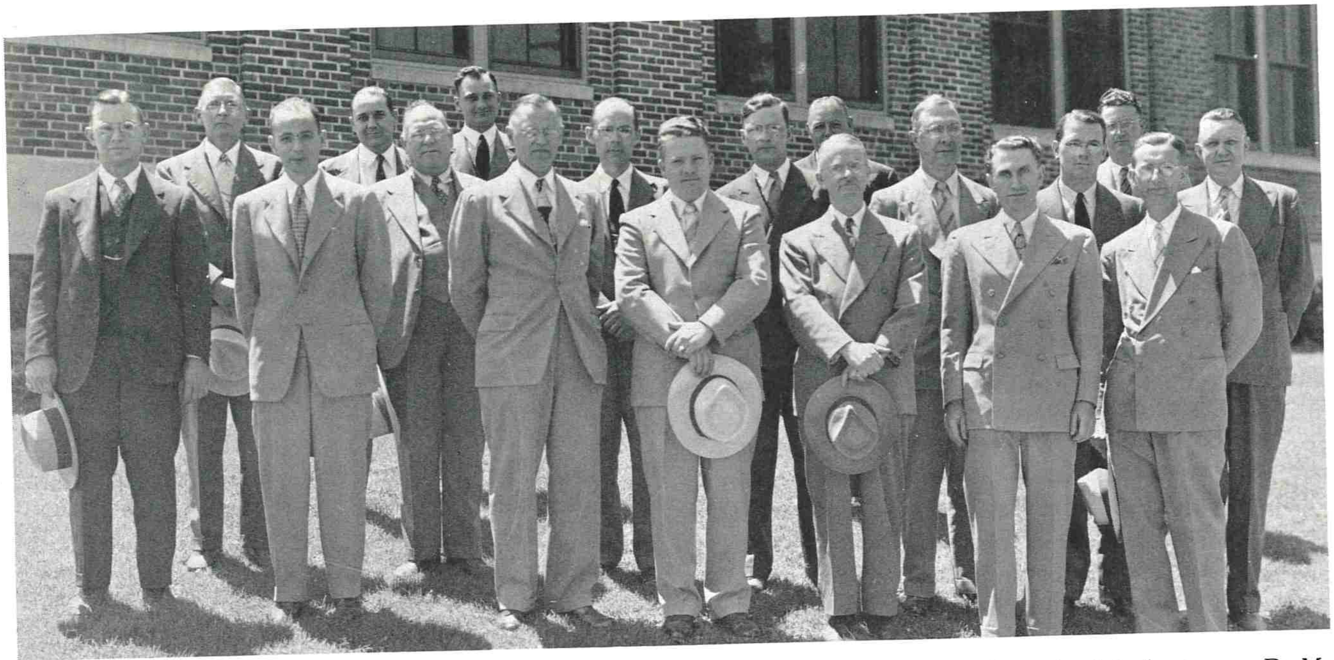

Figure 10. The Research Committee of the National Cheese Institute, June 30, 1944. From the left, front row: D. M. Greer, Wm. O. Beers, Norman Kraft, Sergei Pope, Wayne Bryant, C. H. Parsons, A. B. Erekson, Ed. Freidel. back row: G. H. Wilster,* Z. D. Roundy, David D. Nusbaum, M. W. Yale, A. M. Swanson, S. A. Hall, L. K. Briggs, Fred Feutz,* Robert Farrar,' W. C. Frazier.* (* = Guests)

which have been shared with industry. Typical of such projects were studies on use of sorbic acid and sorbates, packaging and labeling, and staphylococcus food poisoning.

The Research Committee, which advises the Board of Directors as they allocate funds for research, is composed of leading cheese specialists who meet frequently to discuss current and common problems. The committee looks for ways to improve manufacturing procedures and quality of cheese and cheese products. Through its concern with research problems, and acting through the Directors of the Institute with the aid of the Institute's public relation and communication facilities, the Research Committee has been a powerful factor in promoting the progress and protecting the welfare of the industry.

The National Cheese Institute is an outstanding example of close liaison and cooperation between governmental agencies, industry, and scientific associations. It has made this trade association a powerful means of aiding industry members in the development of sound administrative policies and practices.

The World War II Decade

The 1940s tested strength, technology, and adaptability of the process cheese industry. It was a period of strenuous effort to satisfy food requirements of the military, civilian population, and allies. Regulations and restrictions of pricing, procurement, manufacturing, equipment, and labor complicated industrial actions and efficiency. Controls by the War Production Board, War Manpower Commission, Selective Service, Office of Price Administration, Federal subsidies, and the Set Aside program, all contributed to pressures on the cheese industry. Coupled with these controls was the insistent demand by the armed forces for cheese products, particularly processed American cheese in 7-lb. cans.

By 1940 the basic patents on process cheese covering heating and packaging had lapsed, although newer patents still restricted use of some emulsifiers, cookers, and fillers. New processing operations were starting. Men with experience were being hired by new companies or were acting as consultants. Basic information was also available in original patents and in scientific and trade publications *(32, 36, 39, 87, 159, 217, 224, 227, 230, 231, 233)*. Some cheese processors were actively promoting the sale of private or "house label" process cheese packaged under the customer's brand name. This had begun in the 1930s but during the 1940s it became firmly established as a major method of process cheese merchandising.

Materials

The war period caused shortages of many materials. Supplies were not always obtainable. Tinfoil was scarce and eventually restricted to military use. In 1940 processors were experimenting with transparent wrappers in place of foil, and with paper replacements for wooden boxes. The transparent wrappers were succeeded by Cellophane coated with a mixture of wax and latex. In improved form, this wrapper served better than foil. The paper boxes became standard containers for 2- and 5-lb. loaves by 1942.

Stainless steel could not be obtained readily for new equipment, but by 1940 the industry had made tremendous progress in equipment design and construction. Powerful shredders and milling machines were used instead of food grinders. Horizontal cookers had replaced vertical kettles in large operations. Package filling machines, frequently designed or modified by processors to suit specific needs, could deliver up to 2,400 5-lb loaves, 2,640 2-lb. loaves and 6,000 4-oz. cans per hour.

Military

The armed forces were important customers of the process industry in the 1940s. Cheese was a high priority food. Process cheese was well accepted by personnel. It had high nutritive value, excellent keeping quality, and durability under unfavorable conditions. The Quartermaster Corps issued specifications for special modifications of process cheese spreads for use in field rations. These modifications, in 4-oz. cans for individual ration packs, included mixtures of cheese with cooked, chopped ham and bacon, as well as caraway, pimento, and smoke flavor. Some of these items became popular in postwar trade. Nutritive value in these small units was increased by adding approximately 5% butter to the cheese. This mixture had to be made under a "filled cheese" restriction and accounted for to the U. S. Treasury under congressional action of long standing.

Process cheese was needed in larger units for military kitchens and lend-lease purposes. These too had to stand unfavorable storage conditions and cans with interior protective lacquer and exterior camouflage coatings were selected to serve this purpose. In February 1943, the Wheeler Corporation, Green Bay, Wisconsin, was awarded a $3.5 million contract to pack 12,000,000 lb. of processed American Cheddar in 7-lb. cans. This was the largest single contract of its kind undertaken in the cheese industry up to that time. Contracts with other operators soon followed. New techniques had to be developed and controlled to meet problems of composition and weight/volume limitations of the standard No. 10 can.

Processors, acting as authorized assemblers, sold cheese to designated government agencies. They were required to grade, paraffin, and test the cheese. Inferior lots were excluded from government shipments and had to be replaced with satisfactory cheese. Some had to be specially packed for export. Strict accounting was required.

In 1943, government officials were confronted with demands for more milk fat by our allies, especially Russia. Plans were proposed to take fat from cheese, cheese products, and butter by lowering fat standards. A meeting of industry leaders was called in Chicago by the National Cheese Institute to discuss the merit and consequences of such action. Manufacturers, producers, dealers, assemblers, and regulatory agencies reacted strongly against this proposal. A committee was sent to Washington immediately to present the objections of the industry. The Government dropped the idea.

Government buying

The Government began buying cheese on the Wisconsin Cheese Exchange in Plymouth, Wisconsin in July 1941 to supply Army posts and to export to our allies. Purchases continued in various forms and in different programs throughout the 1940s, and, of course, Government purchases, or failures to buy, affected price levels. Buying was limited to U. S. No. 1 grade until July 1942 when, because of a large surplus of No. 2 grade, the Government bought a few cars of that grade at a substantially lower price. J. J. Gaffney, acting as representative of Land O'Lakes, Inc., Minneapolis, Minnesota, purchased cheese on the Wisconsin Cheese Exchange for the U. S. Department of Agriculture. In 18 months Land O'Lakes thus purchased 120 million pounds of cheese (3,200,000 lb. in one day) and performed this function for U.S.D.A. for 1/8 cent per pound.

Set Asides

The advent of the Set Aside Order in 1943 ended Government buying and substituted for it the requirement that some portion of all Cheddar cheese produced be set aside for use in the war effort. Dealers sold Set Aside cheese directly to the Army, Navy, or the Government. Most of the Set Aside cheese was purchased by processors for producing American Process cheese in cans or 5-lb. loaves for military or other purposes. Set Aside requirements reached a high of 70% of all Cheddar during some months, but varied according to Government needs. The Set Aside requirement was legally binding and any company failing to comply had their cheese requisitioned. Cheese available for civilian use fell from 6.8 lb. per capita in 1942 to 4.8 lb. in 1943.

The demand for cheese caused by the limitations of the Set Aside orders caused keen competition for non-Set Aside cheese for civilian use. . In 1945, some processors and assemblers purchased cheese factories while others developed the plan of leasing factories to protect their sources of supply. Leasing made it possible to pay the farmers a premium for milk. Although leasing did not circumvent the Set Aside orders nor violate price regulations, the Office of Price Administration (OPA) objected. The courts denied an injuction to OPA to stop leasing. The spreading of factory leasing alarmed some farm leaders. A bill was introduced into the Wisconsin legislature to outlaw this "threat" to the independent factory. Opponents of the bill argued that large companies would leave the state if the leasing were prohibited. The bill failed to pass. OPA's appeals from the Wisconsin District Court decision were eventually dismissed in December 1945. Leasing agreements were practically all ended in 1946, but ownership of factories by some buyers still continued.

The benefits of controlling conditions of production and the assurance of a dependable supply of cheese of desirable quality encouraged some processors to operate their own factories. Such factories provided facilities to develop new products, to improve efficiency, to decrease costs of procurement, and to achieve control of quality. One of the significant results of factory control, for example, was the introduction of curing Swiss cheese in film-wrapped blocks, perfected in the research laboratories of the Kraft Foods Company.

When Set Aside percentages were decreased in June 1945, some factories stopped making Cheddar to divert milk into more profitable outlets. Government holdings were high, so high in fact that orders for 5,000,000 lb. of process cheese were cancelled. When the Army offered several million pounds of Swiss for sale the following September, the cheese industry demanded an investigation of military holdings to prevent further demoralization of the cheese market. Set Aside continued as a market factor when the Marshall Plan enabled Britain to buy 50,000,000 lb. of Cheddar in 1948 and 110,000,000 lb. in 1949. About 40% of this cheese was processed Cheddar.

Price controls

In 1942, Secretary of Agriculture Claude Wickard, established the Food Production and Food Distribution Administrations to assume full responsibility for controlling the nation's food supply. In April, 1942, price regulations by the OPA set a base price of 23-1/4 cents at Plymouth, Wisconsin on U. S. No. 1 Cheddar with a premium for low moisture. Outside of Wisconsin, Cheddar was priced at 23-1/4 cents plus the cost of freight from the point of origin to Plymouth, even though the cheese was not destined for Wisconsin. This resulted in a higher price for cheese outside Wisconsin than for the same product closer to Plymouth. The Wisconsin Cheese Makers Association objected to this "Plymouth Plus" price and to the premium for low-moisture cheese. This premium was said to discourage the making of high moisture cheese for the natural cheese retail market. Director Herman Ihde of the Wisconsin Department of Agriculture castigated OPA for these price policies claiming that they unduly favored process cheese production. It was at about this time that makers began to complain that every government regulation benefited the processor at the expense of the makers, distributors, and consumers of natural cheese.

So through the war years, the OPA adjusted prices, but never to everyone's satisfaction. Price orders even fixed rates of hauling cheese, prices of used cheese boxes, as well as prices of all varieties of cheese other than Cheddar. Control orders became so numerous, all inclusive, and complicated that processors and assemblers as well as cheese producers joined in asking for relief and clarification of orders. The National Cheese Institute, whose members were handling 75% of all U. S. cheese, called for reviews of OPA actions by the government's Cheese Advisory Committee.

The year 1946 was marked by struggles to be rid of OPA and its controls. Dealers held back cheese supplies while waiting for relief. The National Cheese Institute petitioned control agencies, the U. S. Department of Agriculture, and President Truman for an increase of 25% in Cheddar prices to stop the diversion of cheese milk to other outlets, calling inaction "incomprehensible." Black markets flourished. Production of Cheddar modifications and foreign varieties with higher profit margins took milk from Cheddar factories.

The Wisconsin Cheese Makers Association in May 1946 voted to hold Cheddar cheese off the primary market. Ohio Swiss makers joined in the action. On June 17, 1946, makers sold their holdings at the new price established by OPA and claimed a profit of $3,000,000. Cheese prices were de-controlled temporarily in July 1946 when President Truman refused to extend OPA authority. In November of that year prices of Cheddar reached a new record high of 50 cents a pound, largely resulting from extra demand for Cheddar from England. Swiss cheese sold at 59 cents per pound.

Ration points

The ration point system of controlling use of cheese by consumers imposed a second monetary system on the process cheese industry in 1943. Every processor, factory, and assembler was designated a primary distributor and was required to register with OPA by filing regular inventory reports starting March 29, 1943. OPA required records of acquisitions and transfers by weight and by ration points according to point values assigned at the time. A ration bank account was opened by all primary distributors in a bank which received point credit authorization and deposits of points, and which honored checks on such accounts.

Consumers were given enough points to purchase only about 90% of their 1935 to 1939 average consumption. Makers and distributors of natural cheese asked OPA, without success, for lower point values than those on process cheese.

Cheddar cheese was such a high-point item that consumers chose lower-point "foreign" varieties. OPA countered this trend by raising point values of the foreign varieties while the War Food Administration restricted their manufacture in the United States so that production of Cheddar would not be decreased. Ration points were discontinued when free markets were restored.

"Conspiracy" and the Wisconsin Cheese Exchange

The so-called "conspiracy" trials climaxed a long period of investigations of trading practices which began in the 1920s *(162)*. The Federal Trade Commission (FTC) reported in 1928 on its study of the Wisconsin Cheese Exchange. The Wisconsin Department of Agriculture and Markets (WDAM) published its findings in 1931.

The criticisms of the 1928 report of the FTC mentioned the limited volume, the few styles represented, and the same processors, dealers, and assemblers involved in trading on the Exchange. The report of the WDAM in 1931 reached essentially the same conclusions. The WDAM advised that the Boards at Plymouth might well discontinue operations, and suggested that a committee representing all phases of the industry be formed to establish fair prices. The Wisconsin Cheese Exchange refused to participate in such a committee because it would violate the Sherman-Clayton Antitrust Act. This committee system idea was used later in Monroe, Wisconsin where dealers and producers met to establish prices of Swiss and Limburger cheese.

In 1940, the Wisconsin Cheese Exchange was an essential trading place. Its procedures had evolved over a period of 60 years. Its local predecessors were the Plymouth Dairy Board formed in 1879, succeeded by the Plymouth Central Cheese Board in 1909. This latter Board was reorganized, with full membership for dealers only, and incorporated in 1918 as the Wisconsin Cheese Exchange. It soon had a competitor. The Farmers' Call Board was formed in Plymouth in 1921 by about 30 cheese factories; dealers had buying privileges only. In May 1939, only about 10 factories were still active, and interest decreased after the Wisconsin Cheese Exchange adopted new rules which probably hastened the demise of the Farmers' Call Board. These changes increased assembling charges to cover trading costs; for the first time all offers and bids had to be made at a stated price and in rotation so a buyer could no longer bid against a particular lot. A carlot was defined by weight, color, and variety. All cheese sold was identified by age, if over 30 days old, and it had to be from an approved warehouse to protect the cheese until delivery instructions and carrier could be determined. In this manner through the years the Exchange made revisions of rules periodically to meet the changing needs of the industry.

Members of the Wisconsin Cheese Exchange in the period immediately preceding the "conspiracy" trials included processors such as Armour, Borden, Land O'Lakes, National Dairy Products, Shefford, and Swift. Cheese buyers and dealer members included: The Great Atlantic and Pacific Tea Company, J. S. Hoffman, John Kirkpatrick and Son, Pauly and Pauly, Schmitt Bros., and L. D. Schreiber and Company.

These were the conditions obtaining just before indictments were issued against processors and others during the furor of the early years of World War II.

In 1940 to 1942, Federal Grand Juries in New York, Wisconsin, and Illinois met and charged processors, distributors, assemblers, and their key personnel with fixing prices of cheese and conspiracy in trading. The several charges involved individuals, companies, the National Cheese Institute, the Wisconsin Exchange, the Cheese Boards in Gouverneur and Cuba, New York, and the cheese "committee" in Monroe, Wisconsin. One news release noted that "practically the whole cheese industry" had been charged with conspiracy. There were separate actions involving trading in Cheddar cheese, Brick cheese, and foreign-type cheese. In 1941 the Federal Trade Commission ordered suspension of the foreign-type cheese committee of Monroe, Wisconsin which had been following the idea recommended by the Wisconsin Department of Agriculture and Markets in its 1931 report on cheese trading. The FTC charged six companies and the Foreign Type Cheese Dealers Association in Monroe, Wisconsin with conspiracy to fix prices of foreign-type cheese.

The action involving the largest number of defendants was based on the buying and selling of Cheddar cheese. The Grand Jurors of the United States for the District Court of the Northern District of Illinois, Eastern Division, began an investigation in December 1941 culminating in an indictment on March 18, 1942, that named 45 companies and 56 individuals as defendants. The charges stated that the defendants knowingly conspired to fix prices of American cheese and cheese products (i.e. processed cheese) in the United States, that they established unfair terms for transactions, that they used the Wisconsin Cheese Exchange to determine prices, and that they used the National Cheese Institute to establish discriminatory terms for buying and selling. The effect of this "conspiracy," it was charged, was to minimize competition and to depress buying prices on the primary market and to increase selling prices to wholesale and retail distributors, and that these actions of the defendants controlled prices paid for milk going to cheese factories, condenseries, and to fluid milk markets and consequently controlled prices paid by retailers and ultimately the consumers.

The Government elected to try the Brick cheese case before the two involving Cheddar and foreign-type cheese. The charges against the National Cheese Institute and its secretary, George L. Mooney, were dismissed. The cases against the Wisconsin Cheese Exchange, the various dealers and individuals were consolidated into a single trial before Judge Wm. J. Campbell in Federal Court in Chicago. After a long trial the defendants were found not guilty. Almost immediately the suit in the same court against the same defendants in the buying and selling of Cheddar cheese was dropped.

The charges against individuals and companies in the New York court were pressed and resulted eventually in decisions to fine the Cheese Boards in Gouverneur and Cuba, New York as well as certain dealers in Cheddar cheese operating in those areas.

The foreign-type cheese case involved buyers, distributors, and producers who met as a committee in Monroe, Wisconsin at regular intervals in publicized meetings to consider market conditions, prices, and movements of cheese. A representative of the Wisconsin Department of Agriculture and Markets met with this committee to expedite discussions, to act as chairman, and to assist in keeping records of the meetings. The department was not included as a defendant. This fact greatly disturbed Judge Patrick Stone when he learned about it after the conclusion of the case in his court. He sternly criticized the government attorneys for this omission. The defendants in the foreign-type cheese case withdrew pleas of not guilty or pleaded "no contest" in September 1944 and were fined by the court. Defendants stated they were too heavily involved in the war food production effort to justify further efforts in their own defense. John H. Kraft said that the trial had cost his company one-quarter million dollars in expenses and time lost by executives and employees. And so ended the "conspiracy" trials.

Today the Wisconsin Cheese Exchange functions with authority. Prices of transactions recorded on the Exchange are accepted factors in formulas for calculating prices of fluid milk in government regulated markets *(143)*. Changes in rules to promote orderly trading are typical of the working policies of the Rules Committee of the Exchange. For example, trading in cheese in barrels, which are used primarily by processors, began on the Exchange on April 29, 1960. Trading in small styles had been gradually declining for many years and stopped in the late 1960s. In 1971 a rule change deleted small styles, like longhorns, daisies, and midgets. The new rules now provide for trading 40-lb. blocks as well as barrels. Prices quoted allow for freight differentials from Wisconsin so that cost to the buyer trading on the Exchange is equalized, regardless of state of origin. This is like the practice established in 1964 for trading in Swiss cheese. This is now possible because cheese of high quality is being made in all milk-producing states, and the grading service of the U. S. Department of Agriculture offers a standard evaluation of quality accepted by the Exchange. Such efforts of the Rules Committee to clarify or modify rules of trading reflect industry's concern for the principles of fair trading which were defended in the "conspiracy" trials of the 1940s. In view of the broader scope of trading on the Exchange in the past 20 years, its members are considering the possibility of designating it the "National" or "Midwest" Cheese Exchange.

The expressed purpose of the Exchange, as in years past, is to encourage maximum trading of cheese from all parts of the United States as a service to industry, and to conduct it in the proper framework of the overall interest of the public. The Exchange strives for maximum trading between members, with minimum restrictions, at values determined by supply and demand in the nation.

Technology

The development in the World War II decade of canned cheese and its modifications with additives for the army eventually affected civilian markets. During the 1940s combinations were perfected consisting of ripened cheese, like Limburger and Blue blended with unripened Neufchatel and Cream cheese curd. Manufacture of pasteurized cheese foods and cheese spreads with whey and nonfat milk solids became standard items. Critics questioned the public's ability sometimes to distinguish between pasteurized process cheese and the softer modifications with less fat and flavor and more moisture. The 2-lb. packages of cheese foods and spreads were easily confused by consumers who disregarded labels. Such modifications of pasteurized process cheese were carefully studied by the cheese industry and the Food and Drug Administration and questions of composition, ingredients, and labeling were resolved when new standards and definitions were formulated in 1947 to 1949.

Findings of the United States Public Health Service in the mid 1940s favored pasteurization of milk for making cheese. Cheese-borne epidemics of gastroenteritis and typhoid had occurred in California, Indiana, Michigan, and Iowa. The process cheese industry was never involved, but, as indicated elsewhere in this review, it promoted studies of pasteurization of milk for cheese with grants by the National Cheese Institute and by direct help from individual organizations.

During the 1940s the Food and Drug Administration was vigorously enforcing the provisions of the Pure Food and Drug Act and was directing its attention particularly to the dairy industry. Cheese processors recognized the vulnerability of milk and cheese producers. It was common knowledge that many strange objects had been found in cheese, such as nuts, bolts, nails, pencils, watches, and even once a glass eye. But the Food and Drug Administration was even more interested in the presence of critical materials like insect fragments and rodent hairs as evidence of unsatisfactory conditions of milk production and manufacturing.

The National Cheese Institute provided funds to the University of Wisconsin to determine sources of contamination, and methods of detection, identification, and control. Processors and assemblers of cheese began routine checks of all cheese for extraneous matter. Fieldmen were sent to inspect milk supplies and factories, and to instruct operators in preventative control methods. The National Cheese Institute provided funds and personnel to hold meeting of producers and farmers, and to cooperate with agricultural colleges in education and extension programs.

Packaging of natural cheese in consumer units was developed to a practical stage during the 1940s. Processors were among the first to promote this practice and they have continued to do so. Packaging and processing proved to be complementary operations. The selection and printing of natural cheese for packaging always produced irregular cuts, trimmings, and occasional culls or irregulars which could be processed with a minimum of waste. The control of wrapping room sanitation and the mechanization of printing, wrapping, and packing of small units was readily, if not always easily, solved by processors with technical personnel and laboratory control facilities. With their channels of national distribution, processors have become leaders in the packaging and merchandising of natural cheese.

It was during the 1940s that cheese processors applied their merchandising techniques and capabilities to expand in production and distribution of other foods which could be marketed with process cheese and its modifications. These included such items as new varieties of natural cheese and cheese products, candies made with whey, jellies, and other items. Some products like margarine, salad dressings, and mayonnaise had been developed and merchandised before the war; other foods were added in later years.

The significant involvements of processors and others in research, directly or indirectly through their support of the National Cheese Institute, are mentioned in the next section of this review.

ENVIRONMENTAL HEALTH: PROGRAM PLANNING AND IMPLEMENTATION[1]

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ABSTRACT

Environmental quality problems are interrelated and interdependent on developments and trends in personal health protection as well as social and economic considerations. A carefully planned environmental management program can help optimize a local or national health, social, and economic program, if it becomes an integral part of a total community improvement effort.

The economic and legislative foundation of a steadily increasing demand for environmental health services has been reviewed extensively over the past few years at conferences and symposia. Even if environmental science and technology had been standing still the very volumes of this mounting demand would compel us to find more efficient ways to meet it through a given supply of resources. But science and technology have not stood still and their vast growth require organization if research and development are to be translated into a comprehensive program of action.

While the close of 1971 saw pessimism as the dominant mood in assessing both the amount and rate of progress made toward improving environmental quality, there were significant developments which together set a basic framework for bringing about a better perception of solutions to environmental problems.

SIGNIFICANT DEVELOPMENTS

Allow me to briefly sketch these developments in fairly broad strokes, because they are relevant to the goals and objectives of the International Association of Milk, Food and Environmental Sanitarians, and to the implementation of environmental management programs at all levels of government.

Attention given to problems of rural and urban communities has taken several approaches. The Rural Development Act of 1972 (P.L. 92-419) included a substantial effort to rebuild and revitalize the nonmetropolitan communities. The basic purpose of the Act is to provide an effective program to enable rural America to offer living conditions and employment opportunities adequate to impede the steady flow of rural Americans to our nation's large population centers. To assist rural areas in providing essential community facilities, the Act expands the existing loan programs for rural water, sewage, and solid waste disposal to include all other essential community facilities, such as firehouses and neighborhood centers.

In the field of water resources development, the Federal Water Pollution Control Act Amendments of 1972 represents a major investment in the improvement of water quality. These Amendments set as a national goal elimination of the discharge of all pollutants into receiving waters by 1985, and sets interim goals of providing for the protection of aquatic life and wildlife in and on water by 1983.

Recognizing the critical need to prevent and control air pollution, the U.S. Environmental Protection Agency has given notice of its intention to issue regulations setting up a mechanism for preventing significant deterioration of air quality in areas where air pollution levels currently are below the national ambient air quality standards.

In the field of consumer protection, the Food and Drug Administration (FDA) is implementing a 12 part program which is designed to provide the American consumer with specific and new information on the identity, quality, and nutritional value of a wide variety of general and special foods available in the Nation's Marketplace.

And finally, the Nation's fiscal system began in a significant way to acquire elements of balance and flexibility, through the enactment of revenue sharing. One of the major features of revenue sharing is the wide latitude it gives to State and local government officials in spending decisions. It provides flexibility to maximize the discretion of State and local officials in setting priorties with a minimum of Federal regulatons and red tape.

But these developments and several others in the economic, social and environmental health fields have confronted public service programs as never before with substantive, and hard-hitting questions that cover a full spectrum of resource management in the

[1]Presented at the 60th Annual Meeting of the International Association of Milk, Food, and Environmental Sanitarians, Rochester, New York, August 13-16, 1973.

public sector. These questions inevitably focus on effective planning and implementation of programs and services, and deal with such issues as: What are the major goals and objectives? What are the priorities? How are they determined? With what rationale are public funds allocated among these? How do you define success so that officials know what they are accountable for and more importantly, what evidence is needed to support claims of effective delivery? Questions such as these clearly suggest the need for a rational and orderly process for planning and the implementation of specific environmental control programs.

This need is clearly evident at the local level, that level of government which has been grappling with environmental health issues long before they rose to their present proportion of State and nation-wide significance. This is as it should be because the local jurisdictions are closest geographically and jurisdictionally to many of the environmental problems impinging on the health and welfare of their citizens.

Considerations of Planning

As one who has been associated with urban environmental health programs for the past 15 years, I want to share with you some fundamental concerns and issues which have evolved from my own efforts to develop a rational and orderly process for urban environmental health services. At the outset I must confess my complete agreement with Mark Hollis' assertion in 1952 that "The need for a healthful environment is common to all people; it cuts across boundaries of occupation, race, class, and politics. If it differs from neighborhood to neighborhood, and from region to region, it differs not in fundamentals but only in complexity."

This statement, in essence, is the foundation for development of goals and objectives for public efforts of environmental control. The delineation and clarification of these goals are continuing tasks for the environmental health administration because social and political purposes change and conflict, and so do the resources and the techniques available to achieve them.

In the past, public health and environmental health programs have been favored in competition for local funds. Few city councilmen or aldermen would question line-item appropriations for food protection, water quality surveillance, or rat control. This is no longer true because these consumer protection services are generating controversy and resources allocated for them are being carefully examined by the legislative branch of local governments. Today, defending a request for an increased budget can be a frustrating experience if the request is unsubstantiated by the kinds of knowledge obtainable through a formalized program plan and a sound mechanism for evaluating outputs of the program or service.

Food protection

Budgets for food protection can no longer be justified on the basis of the number of inspections per year because inspections are merely *efforts* and food protection activities are designed to *accomplish* the protection of food against infection, insure wholesomeness of food, and meet consumer expectations. Inspections alone will not accomplish these objectives. The program requires the necessary supporting services and facilities including an effective educational program, recordkeeping system, laboratory, and competent legal services.

Often we assume that an environmental health program or a policy is operating within a managed environment. In setting up and implementing a program we expect certain specific events to occur in very much the same manner as a work order initiates production in a factory. This does not really happen so easily, as can be verified by our experience in code enforcement.

There is a tremendous difference between the part of the world we, in regulatory agencies, can manage and the chaos of the uncontrolled world outside with which we must contend. This central fact makes the behavioral responses of those to whom the programs are directed critically important to its success or failure.

Turning again to food protection as an example, the District of Columbia is in the process of amending its General Food Regulations. While the actual task seemed fairly easy, our concern was not so much the legal, technical, and scientific aspects of the regulation but the reaction of the Washington food industry and the consumer groups. We now expect good results in the enactment and implementation of these regulations, not because of how strong or how weak they are, but because so much attention has been paid to the problem and the people involved. These so called exogenous forces come into play not only in the way people behave but also by the very fact that we live in a dynamic world where conditions and attitudes are undergoing constant changes. The inevitability of social and technological change in our society is another factor adding to the importance of the uncontrollability issue in planning and implementation of environmental health programs.

Air pollution

To use in Newark, N. J. and Washington, D. C.

today the same methods of air pollution control that were used in 1940 or 1950 is obviously not feasible. In both cities we experienced substantial increases in the levels of major pollutants especially from automobiles. This is exogenous, people are behaving differently now than they did 20 or 30 years ago, when it may have been easier to encourage commuters to leave their cars at home and use public transportation.

Perhaps we need to think more about probabilities and recognize that in many environmental health program and policy areas we cannot achieve 100% performance. In some programs a 30-40% success ratio may be a good justifiable result. We seldom face this problem in the beginning, when goals and objectives of programs are being formulated. But as Abel Wolman so aptly states: "The real difficulty in quick and easy solutions to problems generated in the environment rest forever in the fact that the issues are rarely if ever black or white."

Housing

No where is this better illustrated than in local efforts to improve housing quality through codes administration. Those of us who have had the day-to-day responsibility for management and control of the residential environment know very well that we cannot separate the social and economic problems of urban dwellers from housing code enforcement.

Each time we intensify housing inspection and housing code enforcement we must be prepared to deal with questions of evictions and abandonment and related tenant-landlord issues. Granted the slum lordism should be combatted with all means at hand but our experience has demonstrated that it is not only distracting but fruitless to focus solely on slum lordism which is more consequence and symptom than it is cause.

The economic and social problems of tenants in these situations may make it extremely difficult to motivate changes in attitudes, habits, and behavior for successful housing maintenance and upkeep. In this setting, a health educator, or social worker with training and experience in the behavioral sciences is far more productive than a graduate engineer, sanitarian, or environmentalist whose background and academic training is often limited to the physical and biological sciences. While there are scores of families that have resisted the effects of substandard neighborhoods, there are many more who lack the personal resources and degree of social committment to accomplish this, and no level of code enforcement can substantially change the quality of their residential environment.

DEVELOPING ALTERNATIVES

Another important consideration in planning and implementation of environmental programs is development of alternatives, different ways of solving this problem or achieving that objective. This task is obviously difficult since it demands creativity. In essence we are trying to get many options on the table to start; then in the next step go back and filter out those that are really not feasible. But unless such alternatives are considered, programs will not stay attuned to changing objectives and priorities, nor will there be a proper balance between cost and effectiveness.

For example can a self-inspection program for environmental hygiene in medical care facilities achieve the same results as a routine inspection conducted by a regulatory agency? In water quality control, is it necessary to duplicate the bacteriological analysis already conducted by the water quality laboratory of the treatment plant? To what extent can we accept the inspections of other regulatory agencies for products (milk or food) originating in their jurisdiction or must we continue to send inspectors across state or local boundaries to ensure the safety of products which are shipped into our own communities?

These are questions which must be considered in comparing alternatives. We must identify explicit "trade-offs," expressing what we have to give up in one alternative to get desirable outcomes from some other alternatves.

In addition we must be very explicit about the constraints we believe to be imposed by a specific environmental health problem. Constraints could be of numerous kinds—technological, legal, or fiscal. For example, meeting the standards imposed by the Clean Air Act of 1970 has several constraints, which have been clearly identified. But constraints are necessarily immutable. Laws can be changed, new revenue sources may be discovered and technological breakthrough may be made. So, what must be considered a constraint today need not preclude an option in the months and years ahead. Certainly the automobile industry is coming to realize this as it attempts to produce a "cleaner" car, through a reduction in vehicle emissions, and comply with the ambient air quality standards.

One of the most annoying issues in the planning and implementation of environmental health services is setting priorities. The difficulties here are both political and practical. Resources are rarely suffcient to do all we like to do so we must set realistic priorities. Will we concentrate manpower and money in air pollution control? In institutional sanitation of jails and prisons? In radiological health, In food protection? In weed lot cleaning? In home injury control? or In rat control and neighborhoods?

As any administrator soon learns several factors help to determine priorities. For example, few local health agencies gave sufficient attention to the problem of rat bites and their sequelae before December 1967. However, in that year rat control became a priority for 26 urban centers in the United States. Why? Because Congress authorized expending Federal funds to reduce rat population in urban areas. Public Law 90-174 the Partnership for Health Amendments of 1967 authorized an increase in Federal funds that may be appropriated for grants under earlier health legislation. Prevention and control of childhood lead poisoning, the control of air pollution, and several other environmental control programs have shifted to the top of the "priority list" because of the availability of funds to carry out these public health programs.

CONCLUSION

Finally, I do not want to convey the impression that because we are constantly aware of the issues, which I have outlined, we are not apt to run headlong into a crisis. Each of us in state and local environmental health services have experienced management-by-crisis, and we have responded very well. But continuously operating in a crisis management environment often motivates us to toss out plans and policies. This is particularly true if plans and policies are not well developed in the first place.

Thus, it is imperative that we develop the best mechanism to determine plans, policies and procedures for providing environmental health services, put them into effect, defend them, and carry them out.

NEW BOOK ON ENVIRONMENTAL HEALTH AND SAFETY

Herman Koren, Associate Professor, Health and Safety with specialization in Environmental Health, Department of Health and Safety, Indiana State University, Terre Haute, Indiana, has developed a book entitled *Environmental Health and Safety* which includes the latest views on institutional health, safety, and infection control. It is the first complete source where the student or administrator can find a detailed overview of all areas of this emerging public health specialty. Numerous programs and methods designed to aid in the solution of health and safety problems are outlined, many of which will prove especially useful to those involved in enforcing or complying with the Occupational Safety and Health Act of 1972.

The latest techniques in microbiology, air sampling, sterilization, detergent and disinfectant evaluation are covered by Dr. Koren. Also included is information that will prove fruitful for those who wish to develop an institutional occupational health program. Each contribution is oriented toward giving the reader a more comprehensive view of practical, workable programs to achieve maximum effectiveness in his exercise of environmental infection control and safety measure.

Students of nursing, community and public health, institutional management, hospital administration, nutrition, and medicine will find this text important and relevant to their field of study. Dr. Koren has also included much material of interest and value for administrators or superintendents who wish the latest information on the mechanics of environmental health and safety. Practicing health and safety specialists can find accurate, comprehensive, practical, and concise guidelines for effective action.

Dr. Koren has been Chief of Environmental Health and Safety, Philadelphia General Hospital; Associate, Department of Preventive Medicine, University of Pennsylvania Medical School, and Chairman, Committee on Hospital Sanitation, National Environmental Health Association. He is a Founder Diplomate, American Intersociety Academy for Certification of Sanitarians (one of 320 environmentalists elected to the academy in the world), and a Member of the Editorial Board of both the Journal of Environmental Health and the Journal of Milk and Food Technology.

Dr. Koren has developed a comprehensive undergraduate Environmental Health Program leading to a B.S. degree in Environmental Health Science. In the first six years the program has grown from 1 to 101 majors and has already graduated 77 students. He developed the internship concept and has placed 167 interns in paid internships in 9 states and Washington, D. C.

RECOMMENDED PROCEDURES FOR PREPARATION AND VENDING OF BARBECUED MEATS COOKED IN ROTISSERIES

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Abstract

Meat and poultry to be barbecued in a rotisserie should be unfrozen or defrosted. They should be cooked until the slowest heating portion is at least 140 F (60 C) as determined by a thermometer and held thereafter at 140 F or higher, or 40 F or lower in cabinets fitted with readily visible themometers. The packaging material for cooked products should have imprinted: store at 140 F or higher, or 40 F or lower. Recontamination of cooked products can be minimized by: disinfection of equipment, avoidance of contact by cooked product with surfaces contaminated by raw product, personal hygiene, and adequate instruction and supervision of personnel who operate equipment and vend merchandise.

Numerous food-poisoning outbreaks have been reported following consumption of commercially prepared barbecued meats. Some of these outbreaks have involved hundreds of people, and fatalities have occurred. The public health aspects of barbecued food have been the subject of a recent review *(1)*.

In the following text, we recommend procedures for handling raw and cooked meat to minimize the probability of microbial food poisoning from consumption of commercially vended barbecued foods.

Recommended Procedures

1. *Raw food*

a. Preferably, unfrozen meat and poultry should be purchased for barbecuing. If frozen, the products must be *completely* thawed before cooking. Unfrozen and defrosted products should be kept refrigerated (33-38 F or 0.5-3.3 C).

2. *Barbecuing*

a. Thorough cooking is required. For rapid heat penetration it is preferable to limit the weight of roasts and poultry to 6 lb. Stuffed poultry should not be cooked in a rotisserie. Each spit in the rotisserie should contain roasts or poultry of equal weight. A meat thermometer, accurate to 2 F (1.1 C), should be used to determine the internal temperature of a barbecuing product. The thermometer should be inserted into the center of the thickest portion of the food; in the case of poultry this is the muscle of the thigh. For most products, an internal temperature of at least 165 F (74 C) must be reached; poultry usually reaches 190 F (88 C). If rare barbecued beef is desired the internal temperature must be no less than 140 F (60 C). When different products are being barbecued at the same time, the temperature of each type of product should be determined.

b. The meat juices that have accumulated and remain after barbecuing must not be used for food in any way.

c. Barbecued products, on removal from the rotisserie, *must not* be allowed to come in contact with contaminated surfaces or raw meat. They should be placed on unused grease-proof paper or aluminum foil.

d. Only sufficient product to supply the anticipated immediate demand should be barbecued; reduce the amount of product stored pending sale. Howver, storage pending sale neither reduces the quality of product nor increases the risk of food poisoning provided that the product is adequately packaged and properly stored (Sections 4 and 5).

3. *Immediate consumption*

a. Products for sale and consumption immediately after cooking do not need to be wrapped but should be maintained at $\geq$ 140 F until served.

b. If products are to be machine-sliced they must not be left on slicing machines for extended periods.

c. Any further preparation of cooked product must be kept to a minimum and, if during such preparation the product temperature does drop, this prepared product should be reheated to $\geq$ 140 F prior to serving.

4. *Packaging and labeling*

a. Products to be stored pending sale must be wrapped, preferably in transparent plastic. Additional packaging, e.g., aluminum foil laminated bags or aluminum foil wrapping, may be used for retaining heat during transportation after sale.

b. The packaging should carry on the main panel of the label, the name of the product and a statement to the effect that it must be stored at a temperature of 40 F (4.4 C) or lower, or 140 F (60 C) or higher.

5. *Storage*

a. Hot packaged products, pending sale, should be held in enclosed hot holding cabinets. The temperature in such cabinets must be 140 F or higher during storage.

b. The use of open display holding units should be discouraged as the ambient temperature of such displays is variable and difficult to control. For limited periods of hot storage this kind of unit is acceptable provided that: *(a)* heating is supplied from below, and infra-red heating from above, *(b)* the products are in single layers only, and *(c)* the temperature of all parts of the products is maintained at 140 F or higher. Defective infra-red heat lamps must be replaced by equivalent infra-red bulbs; ordinary incandescent bulbs must not be used.

c. Products not sold at the end of a day must either be discarded or adequately refrigerated overnight. It is preferable for large barbecued roasts to be cut into smaller pieces to allow rapid cooling.

d. For refrigeration, wrapped products should have their outer wrapping removed. The inner plastic wrapping should be left on.

e. The product temperature of refrigerated barbecued food or the ambient temperature of refrigerators used for storing or displaying such food must be 40 F or lower.

f. Each display refrigerator or hot holding cabinet should contain a thermometer accurate to 2 F, large enough and placed in such a way that it can easily be read by customers. Preferably, manufacturers of holding equipment should include such thermometers as part of the equipment.

g. The stored products may then be sold cold or may be reheated for sale on the following day. No product should be offered for sale after 2 days of storage.

6. *Reheating*

a. Products to be reheated after cold storage should have all wrapping removed just before reheating. They should be reheated to at least 140 F, preferably in a rotisserie operating at about 300 F, repackaged, and stored at $\geq$ 140 F.

7. *Frozen products*

a. If barbecued products are frozen and thawed, they must not be refrozen.

8. *Hygienic requirements*

a. Employees should recognize that raw meat including government-inspected products, and especially poultry, may contain food-poisoning organisms. Such organisms deposited on hands, equipment or surfaces, may remain alive for many hours, and can be transferred to cooked food.

b. Employees should be encouraged to report infected wounds, sores or illness, particularly diarrhea. Such employees should be removed from possible food contact (directly or through contact with equipment or utensils) for the duration of such illnesses. They may, however, be employed in other areas such as in warehouse duties or in handling canned foods.

c. Employees must wash their hands thoroughly before handling barbecued food.

d. Employees should use disposable plastic gloves or disinfected utensils, but not bare hands, for handling barbecued products. Oven mitts must never be used for handling cooked products.

e. Separate tools, trays or utensils must be used for handling the raw, as distinct from the barbecued food, or these must be washed and disinfected before use for barbecued products. Tools, utensils, and rotisserie spits must be stored in a designated place maintained for this particular purpose.

f. Raw products should be handled in a work area separate from that used for cooked products. If this is not possible, clean surfaces, e.g., greaseproof paper or aluminum foil, must be provided for operations involving cutting or packaging cooked products. Barbecued products must be stored in areas and containers separate from those used for raw products.

g. All the work benches, rotisserie equipment, and holding cabinets must be cleaned and disinfected at least once each day, and more often as required. Always start where the barbecued products are held and progress towards the areas and equipment used for preparing raw material. Before cleaning, equipment should be dismantled to expose surfaces which have been in contact with raw or cooked meat. The cleaning tools must in turn be cleaned and disinfected each time after use, or discarded. After cleaning, all surfaces must be disinfected by immersing them in water at 170 F for 30 sec, or in a solution containing an equivalent of at least 50 ppm available chlorine for at least 1 min. Equipment that cannot be immersed in water should be disinfected with a chlorine solution at a strength of 100 ppm available chlorine. Other methods of disinfection which meet the requirements of the official agency having jurisdiction may be used. Refrigerators must also be cleaned and disinfected as frequently as required.

9. *Supervision*

a. Employees should receive specific instructions for correct operation of equipment, proper care for handling raw and cooked products, and maintenance of correct temperatures. Supervision sufficient to ensure correct operation should be provided.

b. The person in charge of a barbecue operation should be responsible for all aspects of the operation and he must ensure that employees follow specific instructions, as outlined in these recommendations, as well as meeting the provisions of the appropriate national, regional, and municipal regulations.

REFERENCE

1. Todd, E., and H. Pivnick. 1973. Public health problems associated with barbecued food. A review. J. Milk Food Technol. 36:1-18.

AN ADDITION TO THE THIRTEENTH EDITION OF *STANDARD METHODS FOR THE EXAMINATION OF DAIRY PRODUCTS:* SINGLE-SERVICE PLASTIC VIALS FOR SAMPLES OF RAW MILK AND CREAM

E. H. MARTH[1], G. W. REINBOLD[2], R. T. MARSHALL[3], D. W. MATHER[4], W. S. CLARK, JR.[5], J. L. DIZIKES[6], W. J. HAUSLER, JR.[7], G. H. RICHARDSON[8], AND W. W. ULLMANN[9]

(Received for publication February 4, 1974)

The Intersociety Council approved the use of nonsterile (within limits) single-service plastic vials as containers for samples of *raw* milk and cream. An announcement of this fact was published *(2)* and comments were solicited about adding this option to the 13th edition of *Standard Methods for the Examination of Dairy Products* (SMEDP) *(1)*. No adverse comments were received and hence the addition to SMEDP, as given below now becomes effective. Persons with copies of SMEDP – 13th edition (1st printing) should add this information to their books. Books of the 2nd printing will contain the information.

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CHAPTER 3. SAMPLING

3.1 Fluid Milk and Cream Samples

3.11 Equipment for collecting samples

c—Sample containers: (4) Single-service leak-proof vials for samples of *raw* milk and cream provided that: *(a)* maximum viable bacterial counts in rinse tests of containers do not exceed 1/ml of capacity; *(b)* containers made according to each different formulation are nontoxic and are not bacteriostatic or bacteriocidal; and *(c)* the closure is designed so the container can be opened and closed easily without contaminating the lip of the vial or the inner surface of the closure.

REFERENCES

1. Hausler, W. J., Jr. (ed) 1972. Standard methods for the examination of dairy products. 13th ed. Amer. Public Health Ass., Washington, D. C.

2. Marth, E. H., G. W. Reinbold, R. T. Marshall, D. W. Mather, W. S. Clark, Jr., J. L. Dizikes, W. J. Hausler, Jr., G. H. Richardson, and W. W. Ullmann. 1973. Proposed addition to the thirteenth edition of *Standard Methods for the Examination of Dairy Products*. J. Milk Food Technol. 36:514, 525.

HOLDERS OF 3-A SYMBOL COUNCIL AUTHORIZATIONS ON FEBRUARY 20, 1974

"Questions or statements concerning any of the holders of authorizations listed below, or the equipment fabricated, should be addressed to Earl O. Wright, Sec'y-Treas., 413 Kellogg Ave., P. O. Box 701, Ames, Iowa 50010."

01-06 Storage Tanks for Milk and Milk Products As Amended

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

28 Cherry-Burrell Corporation (10/ 3/56)
575 E. Mill St., Little Falls, N. Y. 13365

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

1 Chicago Stainless Equipment (5/ 1/56)
555 Valley Way, Northbrook, Illinois 60062

2 CREPACO, Inc. (5/ 1/56)
100 C. P. Ave., Lake Mills, Wisconsin 53551

117 Dairy Craft, Inc. (10/28/59)
St. Cloud Industrial Park
St. Cloud, Minn. 56301

76 Damrow 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

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

127 Paul Mueller Company (6/29/60)
P. O. Box 828, Springfield, Missouri 65801

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

233 Stainless Steel Craft Corporation (4/13/72)
4503 Alger St., Los Angeles, Calif. 90039

21 Technova, Inc. Gosselin Division (9/20/56)
1450 Hebert c. p. 758
Drummondville, Quebec, Canada

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

02-03 Pumps for Milk and Milk Products as Amended

214R Ben H. Anderson Manufacturers (5/20/70)
Morrisonville, Wis. 53571

212R Babson Bros. Co. (2/20/70)
2100 S. York Rd., Oak Brook, Ill. 60621

29R Cherry-Burrell Corporation (10/ 3/56)
2400 Sixth St., S. W., Cedar Rapids, Iowa 52406

63R CREPACO, Inc. (4/29/57)
100 C. P. Ave., Lake Mills, Wisconsin 53551

205R Dairy Equipment Co. (5/22/69)
1919 So. Stoughton Road, Madison, Wis. 53716

180R The DeLaval Separator Co. (5/ 5/66)
Duchess Turnpike, Poughkeepsie, N. Y. 12602

65R G & H Products, Inc. (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)
9201 Wilmot Road, Kenosha, Wisconsin 53140

236 Megator Corporation (5/ 2/72)
125 Gamma Drive, Pittsburgh, Pa. 15238

241 Purity S.A. (9/12/72)
Alfredo Noble #38, Industrial Pte. deVigas
Tlalnepantla, Mexico

148 Robbins & Myers, Inc. (4/22/64)
Moyno Pump Division
1345 Lagonda Ave., Springfield, Ohio 45501

163R Sta-Rite Industries, Inc. (5/ 5/65)
P. O. Box 622, Delavan, Wisconsin 53115

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

219 Tri-Canada Cherry-Burrell Ltd. (2/15/71)
6500 Northwest Drive, Mississauga, Ont., Canada L4V 1K4

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

52R Viking Pump Div.
Houdaille Industries, Inc. (12/31/56)
406 State Street, Cedar Falls, Iowa 50613

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

04-03 Homogenizers and High Pressure Pumps of the Plunger Type, As Amended

247 Bran and Lubbe, Inc. (4/14/73)
2508 Gross Point Road, Evanston, Illinois 60201

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

37 CREPACO, Inc. (10/19/56)
100 C.P. Ave., Lake Mills, Wis. 53538

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

237 Graco Inc. (6/ 3/72)
60-Eleventh Ave., N.E., Minneapolis, Minn. 55413

256 Haskon Inc. (1/23/74)
2285 University Ave., St. Paul, Minnesota 55114

05-11 Stainless Steel Automotive Milk Transportation Tanks for Bulk Delivery and/or Farm Pick-up Service, As Amended

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

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

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

40 Butler Manufacturing Co. (10/20/56)
900 Sixth Ave., S. E., Minneapolis, Minn. 55114

118 Dairy Craft, Inc. (10/28/59)
St. Cloud Industrial Park
St. Cloud, Minn. 56301

66 Dairy Equipment Company (5/29/57)
1818 So. Stoughton Road, Madison, Wisconsin 53716

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

201 Paul Krohnert Mfg., Ltd. (4/ 1/68)
811 Steeles Ave., West Hill, Ontario, Canada L9T 2Y3

232 Litewate Transport Equipment (4/ 4/72)
Division of the Stanray Corp.
4220 South 13th Street, Milwaukee, Wis. 53221

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

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

144 Portersville Equipment Company (5/16/63)
Portersville, Pennsylvania 16051

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

121 Technova Inc. Gosselin Division (12/ 9/59)
1450 Hebert c. p. 758
Drummondville, Quebec, Canada

47 Trailmobile, Div. of Pullman, Inc. (11/ 2/56)
701 East 16th Ave., 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

08-09 Fittings Used on Milk and Milk Products Equipment, and Used on Sanitary Lines Conducting Milk and Milk Products

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

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

245 Babson Brothers Company (2/12/73)
2100 S. York Road, Oak Brook, Illinois 60521

82R Cherry-Burrell Corporation (12/11/57)
2400 Sixth Street, S.W., Cedar Rapids, Iowa 52406

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

184R The DeLaval Separator Co. (8/ 9/66)
Duchess Turnpike, Poughkeepsie, N. Y. 12602

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

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

203R Grinnell Company (11/ 7/68)
260 W. Exchange St., Providence, R. I. 02901

218 Highland Corporation (2/12/71)
74-10 88th St., Glendale, N. Y. 11227

204R Hills McCanna Company (2/10/69)
400 Maple Ave., Carpentersville, Ill. 60110

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

239 LUMACO (6/30/72)
Box 688, Teaneck, N. J. 07666

230 ITT Moreland Products, Inc. (3/27/72)
P.O. Box #34, Wrightsville, Pa. 17638

200R Paul Mueller Co. (3/ 5/68)
P. O. Mox 828, Springfield, Mo. 65801

242 Purity, S. A. (/12/72)
Alfredo Nobel #39 Industrial Pte. de Vigas Tlalnepantla, Mexico

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

227 Stainless Steel Craft Corporation (1/11/72)
4503 Alger Street, Los Angeles, California

89R Sta-Rite Industries, Inc. (12/23/68)
P. O. Box 622, Delavan, Wis. 53155

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

191R Tri-Canada Cherry-Burrell, Ltd. (11/23/66)
6500 Northwest Drive, Mississauga, Ontario, Canada L4V 1K4

250 Universal Milking Machine Division (6/11/73)
Universal Cooperatives, Inc.
408 First Ave. So.
Albert Lea, Mn. 56007

86R Waukesha Specialty Company, Inc. (12/20/57)
Darien, Wisconsin 53114

09-00 Thermomter Fittings and Connections Used on Milk and Milk Products Equipment and Supplement 1, As Amended

32 Taylor Instrument Process Control,
Div. Sybron Corp. (10/ 4/56)
95 Ames Street, Rochester, New York 14601

206 The Foxboro Company (/11/69)
Neponset Ave., Foxboro, Mass. 02035

246 United Electric Controls (3/24/73)
85 School Street, Watertown, Massachusetts 02172

10-01 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

11-03 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 CREPACO, Inc. (10/19/56)
100 CP Avenue, Lake Mills, Wisconsin 53551

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

17 The DeLaval Separator Company (8/30/56)
Duchess Turnpike, Poughkeepsie, N. Y. 12602

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

12-04 Internal Return Tubular Heat Exchangers, for Milk and Milk Products, As Amended

248 Allegheny Bradford Corporation (4/16/73)
P. O. Box 264, Bradford, Pa. 16701

243 Babson Brothers Company (10/31/72)
2100 S. York Road, Oak Brook, Illinois 60521

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

152 The DeLaval Separator Co. (11/18/69)
350 Duchess Turnpike, Poughkeepsie, N. Y. 12602

217 Girton Manufacturing Co. (1/23/71)
Millvill, Pa. 17846

252 Ernest Loffrandoi (12/27/73)
P. O. Box 455, Ferndale, Calif. 95536

238 Paul Mueller Company (6/28/72)
P. O. Box 828, Springfield, Missouri 65801

96 C. E. Rogers Company (3/31/64)
P. O. Box 118, Mora, Minnesota 55051

13-01 Farm Milk Cooling and Holding Tanks, As Amended

240 Babson Brothers Company (9/ 5/72)
2100 S. York Road, Oak Brook, Illinois 60521
11R CREPACO, Inc. (7/25/56)
100 C. P. Ave.
Lake Mills, Wisconsin 53551
119R Dairy Craft, Inc. (10/28/59)
St. Cloud Industrial Park, St. Cloud, Minn. 56301
4R Dairy Equipment Company (6/15/56)
1919 S. Staughton 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)
Duchess Turnpike, Poughkeepsie, N. Y. 12602
10R Girton Manufacturing Company (7/25/56)
Millville, Pennsylvania 17846
95R Globe Fabricators, Inc. (3/14/58)
3350 North Gilman Rd., El Monte, California 91732
179R Heavy Duty Products (Preston), Ltd. (3/ 8/66)
1261 Industrial Road, Preston, Preston, Ont., Canada
12R Paul Mueller Company (7 /31/56)
P. O. Box 828, Springfield, Missouri 65801
58R Schweitzer's Metal Fabricators, Inc. (2/25/57)
806 No. Todd Avenue, Azusa, California 91702
235 Stainless Steel Craft Corporation (4/13/72)
4503 Alger St., Los Angeles, California 90039
249 Sunset Equipment Co. (4/16/73)
3765 North Dunlap Street
St. Paul, Minnesota 55112
216R Valco Manufacturing Company (10/22/70)
3470 Randolph St., Huntington Pk., Calif. 90256
42R VanVetter, Inc. (10/22/56)
2130 Harbor Avenue S.W., Seattle, Washington 98126
170R The W. C. Wood Co., Ltd. (8/ 9/65)
5 Arthur Street, South, Box 750, Guelph, Ont., Canada
16R Zero Manufacturing Company (/8/27/56)
Washington, Missouri 63090

14-00 Inlet and Outlet Leak Protector Plug Valves for Batch Pasteurizers, As Amended

122R Cherry-Burrell Corporation (12/11/59)
2400 Sixth St., S. W., Cedar Rapids, Iowa 52406
69 G & H Products Corporation (/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. Thomsen & Sons, Inc. (11/20/57)
1303 43rd Street, Kenosha, Wisconsin 53140

16-04 Evaporators and Vacuum Pans for Milk and Milk Products

254 Anhydro, Inc. (1/ 7/74)
130 S. Washington St., North Attleboro, Mass. 02760
132R A.P.V. Company, Inc. (10/26/60)
137 Arthur Street, Buffalo, New York 14207
111R Blaw-Knox Food & Chemical Equip., Inc. (2/12/59)
P. O. Box 1041
Buffalo, N. Y. 14240
164R Anderson IBEC (4/25/65)
19609 Progress Drive
Strongsville, Ohio 44136
107R C. E. Rogers Company (8/ 1/58)
P. O. Box 118, Mora, Minnesota 55051

186R Marriott Walker Corporation (9/ 6/66)
925 East Maple Road, Birmingham, Mich. 48010

17-00 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
137 Ex-Cell-O Corporation (10/17/62)
P. O. Box 386, Detroit, Michigan 48232
220 Haskon, Inc., Package Equipment Division (4/24/71)
2285 University Ave., St. Paul, Minnesota 55114
211 Twinpak, Inc. (2/ 4/70)
2225 Hymus Blvd., Dorval 740 P.Q.

19-00 Batch and Continuous Freezers, For Ice Cream, Ices and Similarly Frozen Dairy Foods, As Amended

141 CREPACO, Inc. (4/15/63)
100 C. P. Avenue, Lake Mills, Wisconsin 53551
146 Cherry-Burrell Corporation (12/10/63)
2400 Sixth Street, S. W., Cedar Rapids, Iowa 52404

22-03 Silo-Type Storage Tanks for Milk and Milk Products

168 Cherry-Burrell Corporation (6/16/65)
575 E. Mill St., Little Falls, N. Y. 13365
154 CREPACO, Inc. (2/10/65)
100 C. P. Ave., Lake Mills, Wisconsin 53551
160 Dairy Craft, Inc. (4/ 5/65)
St. Cloud Industrial Park
St. Cloud, Minn. 56301
181 Damrow Company, Division of DEC International,
Inc. (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)
P. O. Box 828, Springfield, Missouri 65801
195 Paul Mueller (Canada), Ltd. (7/ 6/67)
84 Wellington St., So., St. Marys, Ont., Canada
234 Stainless Steel Craft Corporation (4/13/72)
4503 Alger St., Los Angeles, California 90039
165 Walker Stainless Equipment Co. (4/26/65)
Elroy, Wisconsin 53929

23-00 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
209 Doboy Packaging Machinery (7/23/69)
Domain Industries, Inc.
869 S. Knowles Ave., New Richmond, Wis. 54017
258 Haskon, Inc. (2/ 8/74)
2285 University Ave., St. Paul, Minnesota 55114
222 Maryland Cup Corporation (11/15/71)
Owings Mills, Maryland 21117
193 Triangle Package Machinery Co. (1/31/67)
6655 West Diversey Ave., Chicago, Illinois 60635

24-00 Non-Coil Type Batch Pasteurizers

161 Cherry-Burrell Corporation (4/ 5/65)
575 E. Mill St., Little Falls, N. Y. 13365

158 CREPACO, Inc. (3/24/65)
100 C. P. Avenue, Lake Mills, Wisconsin 53551

187 Dairy Craft, Inc. (9/26/66)
St. Cloud Industrial Park
St. Cloud, Minn. 56301

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

166 Paul Mueller Co. (4/26/65)
P. O. Box 828, Springfield, Mo. 65601

25-00 Non-Coil Type Batch Processors for Milk and Milk Products

162 Cherry-Burrell Corporation (4/ 5/65)
575 E. Mill St., Little Falls, N. Y. 13365

159 CREPACO, Inc. (3/24/65)
100 C. P. Avenue, Lake Mills, Wisconsin 53551

188 Dairy Craft, Inc. (9/26/66)
St. Cloud Industrial Park
St. Cloud, Minn. 56301

167 Paul Mueller Co. (4/26/65)
Box 828, Springfield, Mo. 65801

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

202 Walker Stainless Equipment Co. (9/24/68)
New Lisbon, Wis. 53950

26-00 Sifters for Dry Milk and Dry Milk Products

228 J. H. Day Co. (2/28/72)
4932 Beech Street, Cincinnati, Ohio 45202

171 Entoleter, Inc. (9/ 1/65)
Subsidiary of American Mfg. Co.
P. O. Box 1919, New Haven, Connecticut 06510

229 Russell Finex Inc. (3/15/72)
156 W. Sandford Boulevard, Mt. Vernon, N. Y. 10550

173 B. F. Gump Division (9/20/65)
Blaw-Knox Food & Chem. Equip. Inc.
750 E. Ferry St., P. O. Box 1041
Buffalo, New York 14240

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

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

172 SWECO, Inc. (9/ 1/65)
6111 E. Bandini Blvd., Los Angeles, California 90022

28-00 Flow Meters for Milk and Liquid Milk Products

253 Badger Meter, Inc. (1// 2/74)
4545 W. Brown Deer Road, Milwaukee, Wis. 53223

223 C-E IN-VAL-CO, a division of Combustion
Engineering, Inc. (11/15/71)
P. O. Box 556, 3102 Charles Page Blvd., Tulsa, Oklahoma 74101

231 The DeLaval Separator Company (3/27/72)
350 Dutchess Turnpike
Poughkeepsie, New York 12603

226 Fischer & Porter Company (12/ 9/71)
County Line Road, Warminster, Pa. 18974

224 The Foxboro Company (11/16/71)
Foxboro, Massachusetts 02035

29-00 Air Eliminators for Milk and Fluid Milk Products

251 TheDeLaval Separator Company (12/10/73)
350 Dutchess Turnpike, Poughkeepsie, N. Y. 12603

30-00 Farm Milk Storage Tanks

257 Babson Bros. Co. (2/ 7/74)
2100 S. York Road, Oak Brook, Illinois 60521

3A COMMITTEES SIGN NEW STANDARD, REVISION

Three new 3A documents covering complete revisions in the 3A Standards for pumps and for fillers and sealers of single-service containers will become effective Feb. 12, 1975. In addition, a completely new 3A Standard has been adopted for uninsulated storage tanks.

The pump standard was first published in 1947 and amended on several occasions since then. The filler standard, first written and published for fillers of paperboard containers in 1962, is revised in entirety. The new tank standard will serve applications in aseptic processing, and for special product holding where neither refrigeration nor agitation is needed.

On and after the effective date, applications can be made to the 3A Symbol Administrative Council, P. O. Box 701, Ames, Iowa, 50010 for authorization to apply the 3A Symbol to tanks in compliance with the new standard.

The 3A program for dairy equipment cooperators are: (1) dairy processors, users of dairy equipment; (2) dairy industrial suppliers and equippers, manufacturers and sellers of dairy equipment; and (3) public health officials and sanitarians, regulatory officials under whose jurisdiction the equipment is installed and used.

The 3A program for dairy foods equipment, which is voluntarily supported by the national trade associations in the dairy processing industry, has resulted in standards' being issued for over 30 items of dairy industrial equipment. Equipment complying with the standards may carry the 3A Symbol when authorized by the 3A Symbol Council. Generally speaking, 3A standards and practices are accepted in most public health jurisdictions at the state and local level.

EFFECTS OF RIPENESS AND POST-HARVEST TREATMENTS ON THE FIRMNESS, ACIDITY AND CANNING CHARACTERISTICS OF BABYGOLD #6 PEACHES

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Abstract

Effects of ripeness and post-harvest storage on firmness, acidity, and canning characteristics of southeastern non-melting clingstone peaches (as represented by the cultivar Babygold #6) were investigated. Best results were obtained from ripe peaches harvested at 90 to 100% ground color development and canned without further holding. Firmness values of the raw fruit increased one day after harvest but diminished steadily during 10 days storage at 24 and 1 C. Total acidity of raw peaches diminished during storage after harvest. At 24 C the rate of decrease was uniform between 3 and 14 days. However at 1 C the rate of change decreased with increased storage time. Firmness of the canned halves was influenced by ripeness and post-harvest storage. Ripe fruits, and those stored at 1 C, had lower canned product firmness values. Viscosity values of the canned peach syrup and total grade scores were markedly influenced by storage temperature and time. The reduced acidity in Babygold #6 peaches stored for more than three days and canned resulted in a low-acid food in terms of thermal processing conditions.

There is a strong developing interest in the processing of non-melting clingstone peaches in the southeastern United States. The development thus far has been handicapped by a lack of cultivars which are suitable for growing and canning in this region. In addition to variety selection, growers are interested in knowing the most favorable harvest maturity of non-melting clingstone peaches for canning and also in the post-harvest treatments that might be applicable to extend the processing season.

Much of the published information on canning clingstone peaches is for fruit grown in Western U. S. Since these cultivars are unsuitable for growing in the southeastern climate, additional information is needed on those suited to the latter region. Deshpande and Salunkhe *(7)* found that maturity and post-harvest storage of Redhaven peaches affected the biochemical changes and quality of the fruit. Claypool and Davis *(4)* working with clingstone peaches in California found that the rate of deterioration in post-harvest storage was lowest for fruit held at 0 C. They also showed that there was a marked reduction in the acidity of California clingstone peaches held following harvest. However, Woodroof et al. *(11)* found that acidity of freestone peaches changed only slightly during 21 days storage at 0 C.

Boggess et al. *(2)* have reported on the suitability of several new non-melting clingstone varieties for canning in the southeast. One of the non-melting clingstone varieties found to be most favorable in production and canning tests in the southeast is Babygold #6. This cultivar was examined for firmness, acidity, and canning characteristics at two harvesting maturities (ripe and green), two post-harvest storage temperatures (1 and 24 C) and six storage times (0, 1, 3, 7, 10, and 14 days). Changes in composition and quality of both the fresh and canned products were investigated.

Materials and Methods

Fresh fruit selection and evaluation

Babygold #6 peaches were hand-harvested from 6 trees of uniform age and size. Sound healthy fruits were selected and two categories of ripeness were separated visually according to the proportion of ground color. Those having 90 to 100% of developed ground color were designated as ripe. Those having 50 to 75% ground color were designated as green.

A total of 330 fruits were selected for the ripe group and distributed at random into 11 boxes of 30 fruits each. One box was examined initially (0 days), five were stored at 1 C and five at 24 C for examination after 1, 3, 7, 10, and 14 days, respectively. Both storages were at 80% relative humidity. Selection and storage of the green group of fruits were similar. Samples for raw fruit evaluation consisted of 6 fruits of the two ripeness categories taken from each storage treatment. Raw fruit evaluations included firmness, pH, and total acidity measurements. The remaining fruits were canned and evaluated for grade, syrup viscosity, total acidity, pH, and firmness.

Fruit samples from each treatment were weighed before and after storage to determine shrinkage. Any visably unsound fruit was weighed and discarded.

Firmness. Using the 6-fruit sample for each ripeness and storage treatment, firmness was measured. Four readings were taken on each of the 6 fruits at approximately equal distances around the periphery and midway from each end with a Magnus-Taylor Model 30A pressure tester. The plunger of the tester was 5/16 inch in diameter with a 5/16 penetration depth. The skin was removed at each point before making the pressure test. Firmness readings were averaged for each sample.

Total acidity and pH. Following the firmness measurements each fruit was peeled, pitted, and the edible portion blended in an Omni-mixer. The pH was measured on each blended fruit. For total acidity a 10-g portion of each blended fruit was further blended with 25 ml of CO_2-free distilled water then made up to 500 ml. Measurements were made in duplicate. Samples were titrated with 0.1 N NaOH to pH 8.2 using an electronic pH meter. The results were reported as the ml of 0.1 N NaOH required to neutralize 100 g of peach tissue.

Canning

Canning procedures used in this study were those reported by Boggess et al. *(1, 2)* and based on earlier recommendations by several workers including Bitting *(3)*, Cruess *(5)*, Woodroof *(10)*, Culpepper and Caldwell *(6)*, and Van Blaricom *(9)*.

Fruits were pitted with a standard commercial Filper clingstone peach pitter. Peeling was accomplished by means of a continuous lye peeler with overhead lye spray directed on the halves in a cup down position. The lye concentration was 2% and the temperature was 99 C. Following the lye spray, the halves were allowed to move through an oxidation chamber for 1.5 min, then the lye and skin were removed by an air and water spray system. The halves were graded for uniformity of color then filled into No. 2 1/2 cans using 19 oz of fruit and 11 oz of boiling sucrose syrup (40%). The filled cans were exhausted for 6 min in atmospheric steam, sealed, processed 25 min at 100 C, then cooled in water. The canned products were stored at 21 C for at least 6 weeks to allow equalization of the contents. Three cans were selected from each treatment for further evaluation.

Product evaluation

Numerical grade scores were determined according to U.S. Standards for Grades of Canned Clingstone Peaches (Fourth Issue), June 20, 1973. The three cans from each treatment were opened and the syrup and halves separated with an 8-mesh screen. Color, uniformity of size, absence of defects, and product character were rated numerically in comparison with the canned samples of the freshly harvested peaches which were arbitrarily assigned maximum scores for each parameter. The Macbeth standard daylight source (6800 K) was used in grading color. The canned product quality was based upon total numerical grade score.

Viscosity. The viscosity of the canned syrup was measured with a Brookfield Synchrolectric Viscosimeter equipped with a No. 2 spindle, a 500 scale, and operating at 50 rpm. Triplicate readings were taken on the syrup from each can.

Total acidity and pH. These were determined on the syrup in the same manner as for the raw puree above.

Firmness. Firmness of canned halves was measured with a Food Technology Corporation Model TP-1 Texturepress equipped with a Model TR-1 Texturecorder. The operating conditions for the instrument included an universal cell, 300-lb. transducer ring, downstroke time of 30 sec, and a range setting of 20. Three halves from each can were weighed individually and the firmness measured. Results were calculated from the curve peak height and sample weight and reported as kilograms of force per gram of fruit.

Data for the major parameters were analyzed by statistical analysis of variance.

Results and Discussion

Mean values for firmness, total acidity, and pH were significantly affected by fruit ripeness, storage temperature, and storage time.

Changes in firmness (Table 1) showed consistent patterns with an increase occurring during the first day of storage and, except for the ripe fruit stored at 24 C, an increase from 10 to 14 days of storage. The first increase is thought to be associated with changes in turgidity of the fruit following harvest. The second increase following prolonged storage is believed to be linked with a toughening of the tissue partly because of transpiration loss. Deshpande and Salunkhe *(7)* indicated that firmness, although related to maturity, is in itself inadequate to predict the composition and quality of the product.

The total acidity values of the raw fruit (Table 1) dropped markedly during the first day following harvest. Samples held at 1 C tended to stabilize during the next several days and then dropped further after 10 days of storage. At 24 C, the total acidity dropped off rapidly after 3 days of storage. The pH values showed corresponding increases with extended storage.

Physiological (overripe) and pathological decay occurred only in samples held at 24 C for 3 days or longer. The incidence of spoilage was much higher for fruits selected at the outset as ripe than for those first classified as green. Of the former group seven showed evidence of spoilage and 21 were overripe when held 10 days or longer at 24 C. The shrinkage losses, caused by transpiration and respiration, increased steadily with the length of storage. Values were approximately twice as high in fruits stored at 24 C compared with those at 1 C. Losses were approximately 50% higher for the green than for the ripe group of fruits.

Shear press firmness values of canned products (Table 2) did not follow the same pattern as pressure test readings of raw peaches (Table 1). Canned product firmness was consistently greater for the green group than for the ripe group. For the green category, firmness increased in peaches stored up to 3 days and remained steady up to 14 days of storage (Table 2). Firmness values for ripe fruits reached a maximum with products from peaches stored for 3 and 7 days. In general, peaches stored at 24 C produced firmer canned products than those stored at 1 C. Difference was most striking in fruits that were stored from 3 to 10 days.

Viscosity of the canned product syrup was influenced significantly by fruit ripeness and storage time (Table 2). Syrups from fruits of the green category were consistently more viscous than those from the ripe group. The decrease in syrup viscosity with increasing storage time followed the same general pattern as the decrease in firmness of raw fruit. The influence of storage temperature on syrup viscosity was less pronounced, yet the values were significantly higher for the fruits stored at 1 C for 10 and 14 days than for those held at 24 C for the same durations.

The total grade scores (Table 3) indicated a

TABLE 1. MEAN VALUES FOR FIRMNESS, TOTAL ACIDITY AND pH OF BABYGOLD #6 PEACHES AS AFFECTED BY RIPENESS AND POST-HARVEST STORAGE[1]

Storage time (days)	Firmness (lb)		Firmness (lb)		Total acidity (ml 0.1 N NaOH)		pH	
	Green	Ripe	1C	24C	1C	24C	1C	24C
0	15.30a	14.82a	15.57a	14.54ab	76.36a	76.36a	3.63e	3.87d
1	15.94a	15.65a	16.11a	15.48ab	62.64ab	67.87ab	3.87d	3.83de
3	12.17b	12.13b	13.57b	10.72c	65.64ab	64.36ab	3.90d	4.02cd
7	10.19bc	7.99d	10.69c	7.49d	59.48bc	48.49cd	3.94cd	4.16c
10	8.52cd	7.86d	10.63c	5.75d	58.75bc	35.64de	4.16c	4.63b
14	11.03b	6.97d	11.17c	6.84d	45.77cd	19.38e	4.01cd	4.86a

[1]Within each group of 12 means, values followed by the same letter or letters do not differ significantly at the 5% level.

TABLE 2. MEAN VALUES FOR FIRMNESS AND SYRUP VISCOSITY OF CANNED BABYGOLD #6 PEACHES AS AFFECTED BY RIPENESS AND POST-HARVEST STORAGE[1]

Storage time (days)	Firmness (kg/g)		Firmness (kg/g)		Viscosity (cps)		Viscosity (cps)	
	Green	Ripe	1C	24C	Green	Ripe	1C	24C
0	.472de	.472de	.472cde	.472cde	71.78a	71.78a	71.78a	71.78a
1	.507cd	.309f	.433de	.383e	61.78ab	38.89e	52.56bc	48.11bc
3	.631ab	.561bc	.452cde	.739a	66.28a	55.22bc	54.33b	67.17a
7	.650a	.548bcd	.513cd	.684ab	65.89a	42.44de	55.78b	52.56bc
10	.654a	.468de	.492cd	.632b	49.67cd	34.33ef	47.22bc	36.78d
14	.593ab	.404e	.464cde	.534c	38.56e	27.72f	42.33cd	23.95e

[1]Within each group of 12 means, values followed by the same letter or letters do not differ significantly at the 5% level.

TABLE 3. MEAN VALUES FOR TOTAL GRADE SCORE, TOTAL ACIDITY AND pH OF CANNED BABYGOLD #6 PEACHES AS AFFECTED BY RIPENESS AND POST-HARVEST STORAGE[1]

Storage time (days)	Total grade score		Total grade score		Total acidity (ml 0.1 N NaOH)		pH	
	Green	Ripe	1C	24C	1C	24C	1C	24C
0	100.0a	100.0a	100.0a	100.0a	54.72a	54.72a	4.23d	4.23d
1	96.0d	97.8bc	96.3b	97.5b	46.04bc	49.32b	4.03f	4.10ef
3	97.2cd	99.2ab	97.0b	99.3b	48.58b	39.81d	4.07ef	4.22de
7	92.8e	94.2e	96.5b	90.5c	42.44cd	26.38e	4.22de	4.55c
10	88.5f	93.3e	96.0b	85.8d	42.76cd	27.85e	4.32d	4.85b
14	77.7h	79.2g	96.8b	60.0e	42.27cd	24.08e	4.25d	5.00a

[1]Within each group of 12 means, values followed by the same letter or letters do not differ significantly at the 5% level.

generally lower product quality from fruits having a lesser ripeness when harvested. Grade scores for canned products from both the green and ripe categories became progressively lower as the storage time was increased. A major part of the quality reduction was associated with trimming that was necessary.

Changes in total acidity and pH values of canned products (Table 3) followed the same pattern as those of the raw fruits (Table 1). The higher pH values for canned products when compared with those of raw fruit provide further concern for practices that involve holding of non-melting clingstone peaches following harvest. There is not only the factor of quality reduction but also that of the potential health hazards involved in processing low-acid foods.

The Babygold #6 cultivar, while not all-inclusive in the properties of southeastern non-melting clingstone peaches, is nevertheless typical of the cultivars suitable for commercial canning. Results of this study establish some of the patterns in product quality variation that can be expected from differences in ripeness of fruits at harvest and from holding peaches after harvest under different storage conditions. Most favorable results were obtained with fruits having a high proportion of ground color at the time of harvest, then canned without further holding. Limited post-harvest storage appeared possible to level out harvesting and processing schedules. However, the reduction in product firmness and the increase in spoilage incidence were obvious detriments to extended post-harvest storage. The most critical and least evident factor in the holding of non-melting clingstone peaches for storage appears to be the reduction of acidity. Such reduction has major implications in the processing requirements to prevent spoilage and to guard against food-borne disease hazards. The lesser acidity also reduces flavor acceptance of the product by disrupting the desired sugar:acid ratio.

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Co-Chairman—Clarence K. Luchterhand, Wisconsin Division of Health, Room 570, 1 West Wilson St., Madison, Wisconsin 53701.

CALIFORNIA ASSOCIATION OF DAIRY AND MILK SANITARIANS CONFERENCE

Dr. Bartelt, assistant director of California's Department of Food and Agriculture, welcomed approximately a hundred members of the dairy industry to the 55th annual meeting of the California Association of Dairy and Milk Sanitarians, held jointly with the California Fieldmen's Conference October 23, 24 and 25 at the Sacramento Inn in Sacramento.

Dr. Bartelt's remarks set the theme of the sessions to follow—"Looking Ahead"—the future and change —with inevitable resistance.

Trends to One Grade of Milk

With that the conference launched into a discussion of the trend to one grade of milk and its economic impact on the Grade B Dairy Industry. Dr. Bartelt noted that 90% of California's milk is produced in Grade A dairies with a lot of the manufacturing milk coming from the surplus of the Grade A operations. "For about five years I've looked at milk processing as a whole and wondered how long we're going to continue with two different standards. I think Grade B will be discontinued within the next few years."

Metric System

Another look into the future—the economic impact on the dairy industry of the metric system. Charles Beardsley, supervisor of special products with the Bureau of Weights and Measures, said that metrication is fast approaching in spite of public resistance.

However, it has hit a snag. The AFL-CIO wants a subsidy for those who would have to get new types of tools. And how would it effect the dairy industry? For the benefit of simplified record keeping would be the cost of new hardware: scales, charts, meter dials. For example, milk cartons: if regulations required the standard for milk should be a liter rather than a quart, cartons would have to be made larger, carton factories retooled and filling machines, adjusted or adapted.

"Naturally there is resistance to change," Beardsley said. "I'm sorry I can't tell you what it is going to cost your industry to convert to the metric system. I do know that if we can get over our resistance, in this system we will find one that is logical and much simpler than what we have used in the past."

Nutritional Labeling

Nutritional labeling is another step ahead but could be met with resistance. Marie Ferree, newspaper columnist and consumer marketing specialist from the University of California at Berkeley, speaking from the consumer's point of view said, "I believe nutritional change is not only met with resistance but downright resentment. Not on the part of us consumers. We're the ones who ask for it.

Dr. W. Dunkly shows a soft "spreadable" butter with high polyunsaturated fats, produced by experimental feeding of cows.

Pat Dolan, President, California Association of Dairy and Milk Sanitarians.

Now what is the consumer going to do with all this marvelous nutritional information? Miss Ferree admitted that it will take a while, but in a general way it is believed the consumer will learn the value of good nutrition from this. The number of calories may be the thing that will sell nutritional labeling first. If calorie count is there, it's reasonably certain the consumers will read a little further.

Research

A further look into the future was an overview of research activities in food science presented by a panel of scientists from the Department of Food and Technology at the University of California, Davis. Included in the panel was Dr. Allen Johnson from Australia, a key researcher in the Division of Food Research with Commonwealth Scientific Industrial Research Organization near Sydney. Other members were Dr. John Bruhn, chairman of the panel; Dr. B. S. Schweigert; Dr. Richard Bernhard and Dr. Walter Dunkley.

The Whey Problem

One area of research is what to do with whey—a problem that comes up in almost every dairy gathering. With increasing demands for cottage cheese and other cheese products, whey becomes an increasing problem of disposal.

Dr. Bernard, one of the top researchers working on the project said over a billion pounds of whey is produced a year. "Our problem is, how can we utilize it? How can we just keep it from polluting our waters?"

Metal Concentration in Dairy Products

Dr. Bruhn attacked a problem of sensitivity with many in the industry—heavy metal concentration in dairy products. A recent report in the Consumers Union publication dealt with the lead concentration in evaporated milk.

"Why are we in the dairy business concerned?" asked Dr. Bruhn. "We need an information base to present to officials and regulatory agencies. We want firm data as to certain concentrations of these heavy metals in our dairy foods.

Milk and Its Fats

The story shared on the panel by Dr. Dunkley and Dr. Johnson, a visiting colleague from Australia, is one of the most important and exciting research breakthroughs in milk production in recent years. It's changing the composition of milk fats to specified programs through the cow's digestion.

Dr. Johnson summarized the potential significance of their work: "We can produce oxidation-resistant milk products; we can produce cheese with different textures, dairy products with new and different flavors, and provide diets from ruminent animals for restricted patients, also improve diets for dairy cattle."

Banquet

Although "Looking Ahead" had been the theme for the entire conference, the annual banquet held Wednesday, October 24, made a complete switch to a look at the past.

Neil McPherson, retired representative of the California Dairy Council and dairy historian, turned toward history. Showing pictures of the old-timers, he spun fascinating tales of the real pioneers of California's Dairy Industry.

From the many compliments on the quality of speakers and program, Chairman Pat Dolan assessed the conference a great success. The many who attended the conference left with a feelin of anticipation—and just a little trepidation—of the prospects that lie ahead.

THE STUDY CONTINUES BETWEEN IAMFES AND NEHA

The straw ballot last year of both organizations indicated the majority were in favor of continued study toward the two organizations consolidating.

Mr. Walt Wilson of IAMFES and Mr. Joe Martin of NEHA have been appointed as liaison persons of each of these organizations to make further study. Mr. Wilson met with NEHA officials in San Francisco at which time the following was agreed upon:

That both organizations' positions as affirmed by results of membership poll in 1973 and confirmed by at least a majority vote of the respective Board of Directors of each organization, are in fact interested in carrying on discussions that may lead to some form of getting together in one new organization.

That the basis or starting point for those talks be the philosophical position presented by the 7th Draft of the proposed by-laws drafted in 1968 by the Joint Consolidation Committee of the then N.A.S. (NEHA) and IAMFES, jointly chaired by Wally Lawton and Bill Walters.

That the results of the current vote on eligibility for membership in NEHA would have an effect on NEHA position relative to further discussion.

Note: Proposed changes, if adopted, make persons qualified as active members instead of associate members which is presently true of IAMFES.

That the proposed amendments to 1968 Draft Seven by N.A.S. (NEHA) are not considered by either organization as their position at this time.

If the governing bodies agree to these statements, then the minimum next move by each body will be the naming of persons to negotiate the details of carrying out its intent.

After approval of each governing body, it is expected that each organization will discuss it at their next respective annual meeting. This discussion should include whether or not to proceed with a mail ballot vote of the active membership, the results of which would be binding on both organizations if a majority vote of approval is made by both memberships—each majority determined separately, not as one combined vote.

The Board of Directors of the IAMFES met in Florida on November 28, 1973 and ratified the above principles.

The NEHA Board took action in October and endorsed the same principles, also. It has been further agreed by the two organizations that they will discuss this further at their annual meetings that are coming up this year.

PUBLICATIONS RECOMMENDED BY THE DAIRY FARM METHODS COMMITTEE

1. *Milk Flavor Handbook, Tri-State Milk Flavor Program.* 1973 edition. Prepared by: David K. Bandler, Cornell University, Sidney E. Barnard, Pennsylvania State University, Dick H. Kleyn, Rutgers University. Write To: Cooperative Extension Service, Pennsylvania State University, 213 Borland Laboratory, University Park, Pennsylvania 16802. Cost, $1.00.

2. *Dairy Plant Fieldman-Hauler-Grader and Tester's Manual.* 1973 edition. By: V. S. Packard-Extension Division, University of Minnesota. Write To: Agriculture Extension Service, University of Minnesota, St. Paul, Minnesota 55101. Cost, $1.C0.

3. *The Missouri Approach to Animal Waste Management.* Bulletin MP 232. (Guideline to Planning and Designing Animal Waste Management Systems in Missouri) Published by: Missouri Water Pollution Board and Extension Division-University of Mo., Columbia, Missouri. Write to: Agriculture Engineering Dept., Extension Division, University of Missouri, Columbia, Missouri. Cost, $1.00.

4. *The Way Cows Will Be Milked On Your Dairy Tomorrow.* (New 7th Edition With Automation Supplement) Prepared by: Babson Bros. Dairy Research Service, 72 Pages. Write To: Babson Bros., Dairy Research Service, 2100 South York Rd., Oak Brook, Illinois 60521. Cost, $1.00.

5. *Milk Quality Assurance Handbook.* 1973. Prepared by: David K. Bandler-Cornell University, Sidney E. Barnard-The Pennsylvania State University. Write To: Cooperative Extension Service, Pennsylvania State University, 213 Borland Laboratory, University Park, Pennsylvania 16802. Cost, $1.00.

6. *The Story of Vacuum* (As Utilized in Milking Systems On The Dairy Farm). 137 Colored slides with tape cassette —Time, 25 min or 35 mm Film strip with record—Time, 25 min. Write To: Babson Bros., Dairy Research Service, 2100 South York Rd., Oak Brook, Illinois 60521. No charge.

7. *Garget-Mastitis With Relation To Milking Machine Operation Time*—38 min-35 mm Film Strip (Color) With Record. (A vividly illustrated story of the work of Dr. Kermit J. Peterson and of the Dept. of Veterinary Medicine, Oregon State University. Stresses the role of milking machine operators in preventing mastitis.) Write To: Babson Bros., Dairy Research Service, 2100 South York Rd., Oak Brook, Illinois 60521. No charge.

DAIRY CHIEF RETIRES

R. L. Van Buren, Chief of the State Department of Food and Agriculture's Bureau of Milk and Dairy Foods Control, retired from the state service January 30.

Van Buren, who has been with the bureau for 35 years, achieved national recognition as a specialist in milk and milk products. He is a longtime member of the Dairy Division of the National Association of State Departments of Agriculture, and recently completed a term as its President.

Van Buren was born in Wellington, Kansas in 1911 and came to California in 1923, where he lived on a ranch in Wood Colony, Modesto. After graduating from the University of California at Davis with the degree of Bachelor of Science, he worked for two and one-half years in the dairy industry. He began his career with the Bureau of Dairy Service in the San Francisco milk testing program in 1938, and was transferred to the manufacturing milk program in Stanislaus County in 1940.

In 1942 he entered the military and began training as an epidemiologist and medical technologist at the National Naval Medical Center in Bethesda, Maryland. He served in the South Pacific Theater for two years and was discharged as a Pharmicist's Mate, First Class.

Van Buren returned to the bureau's manufacturing milk program in Fresno in 1945. In 1946 he was assigned as Specialist in Milk and Milk Products in San Diego, and his area of service included the counties of San Diego, Imperial, Riverside, and a part of Los Angeles County. In 1954 he transferred to Sacramento as Area Supervisor for the northern half of the state, and in August, 1967, was appointed Bureau Chief.

Carson L. Hubbard, Special Assistant in the Division of Animal Industry, is Acting Chief of the Bureau until a permanent appointment can be made.

LETTER TO THE EDITOR

Milk testing needs to be changed

DEAR SIR:

What is the purpose of doing bacteriological tests on raw milk? Is it not to obtain some assurance that the product has been handled in an acceptable manner? While a generation ago the Standard Plate Count (SPC) gave *some* such assurance, with adoption of bulk handling usefulness of the SPC dropped off sharply. Cooling is often substituted for cleaning, but this may not be detected by the SPC. Psychrotrophs have become the most important group of organisms, both as indicators of contamination and as the cause of spoilage. Many psychrotrophs fail to grow on plates incubated for 48 h at 32 C, so milk of mediocre quality passes as Grade A. Thus use of the current SPC often engenders a false sense of security. Time and money spent in doing SPCs is largely wasted. Many progressive producer organizations and plants no longer rely on this test to give them the desired information.

At the 1969 National Conference on Interstate Milk Shipments in Denver, sanitarians from Region VIII of the FDA were unanimous in requesting that the Standard Methods Committee recommend a more meaningful procedure than the current SPC. Their reasons were clearly documented.

The Psychrotrophic Bacteria Count (PBC) is the only one of the commonly used tests found by Hartley and his co-workers to be significantly correlated with production conditions. However, unless a much faster test for psychrotrophs can be developed, our best bet appears to be to improve the SPC by lowering the temperature and increasing the time of incubation. This will greatly improve detection of psychrotrophs, and thus point out more producers who are "cutting corners" and getting away with it.

Many persons responsible for quality control have found it useful to give the psychrotrophs an opportunity to grow by Preliminary Incubation (PI) of samples before plating. These organisms are rarely found in the udder, neglected milk handling equipment and dirty udders being mainly responsible for their presence in milk. By holding samples at 12.8 C (55 F) for 18 h rapid growth of psychrotrophs is encouraged; in some instances the increase is over 100-fold. Thus milk with an SPC of < 10,000/ml *before* PI may have a count of a million *after* such incubation. And with a lower temperature and longer incubation period for the SPC, the value of PI in detecting unsatisfactory sanitary practices should be further increased. Recent studies by a Denver plant have shown that by using PI in their bonus scheme the percentage of samples *after* PI with SPCs of not over 8,000/ml increased from 20.4 to 68.1% in 7 months, while the percentage over 100,000/ml dropped from 23.0 to 2.3%. Before adoption of PI in March 1973, SPCs were done twice monthly for years. It is thus apparent that PI revealed a significant number of producers who were previously "cutting corners" and getting by on the SPC without PI.

With pasteurized products the SPC is of even less value than with raw milk. Certainly it has *very* limited value as an indicator of shelf life. Moseley has shown that with a Preliminary Incubation at 7.2 C (45 F) for 5 or more days, the SPC gives a much better indication of the probable shelf life. And with a lower temperature and longer incubation the SPC will be considerably more valuable here, too, in showing the presence of psychrotrophs. Not all psychrotrophs cause spoilage, but spoilage at refrigeration temperatures is invariably caused by growth of these organisms. Plants get much better value for their money from Moseley's Keeping Quality Test than from doing SPCs on their fresh products, and through line checks can detect the point of contamination and take steps to remedy it. Incidentally, the Denver plant mentioned earlier stopped doing the SPC on fresh pasteurized products and adopted the Moseley test several years ago.

If it is agreed that the real purpose of doing bacteriological tests on raw and pasteurized milk is to obtain some assurance that these products have been handled in an acceptable manner, then all concerned must be responsible to see that the necessary changes are made in bacteriological testing. Those who have long been disenchanted with the SPC will wholeheartedly welcome this progressive step.

Harold J. Barnum
960 Leyden St.
Denver, Colo. 80220

INTERNATIONAL FOOD & DAIRY EXPO SET FOR OCT. 20-24, 1974

Food and Dairy Expo, a major international exposition of equipment, supplies and services staged every two years, will be held Oct. 20-24, 1974 at the Dallas Convention Hall, Dallas, Texas.

The exposition will feature exhibits of processing and handling equipment and components, container and packaging machinery and materials, ingredients, merchandising and refrigeration equipment and promotion, transport and delivery systems, services and supplies, and cleaning and sanitizing systems and materials.

The show is expected to attract officials from the bakery, beverage, brewery, canning, confectionery, dairy, frozen food, meat and related industries. Other visitors will include public officials, sanitarians, educators, consultants, jobbers and exhibitor personnel. As in past shows industry representation will be made up primarily of chief executives and owners, corporate management, plant operations, sales and marketing, engineering and research.

An extensive overseas promotion program is being developed by Dairy and Food Industries Supply Association (DFISA), sponsor of the show. The international program will include worldwide distribution of a special brochure inviting overseas attendance, assistance by the U. S. Department of Commerce in the development of travel plans to the U. S. and pre- and post-show visits to U. S. plants and facilities, designation of the show as a VIP (Visit, Inspect, Purchase) event by the U. S. government, establishment of an international registration desk and lounge at the show, and availability of translators and trade and financial counselors for on-the-spot assistance.

The Food Engineering Forum, a technical session consisting of scientific and technical papers, will be held in conjunction with the Exposition.

Registration is free to anyone with an interest in food processing. The general public is not admitted.

An ample number of rooms has been reserved for Expo visitors in 20 conveniently located hotels in Dallas. Visitors traveling by air will arrive at the world's largest airport, the Southwest Regional Airport.

The Expo will occupy both levels of the new Dallas Convention Hall, located in the downtown area.

For information, contact Fred J. Greiner, executive vice president, Dairy and Food Industries Supply Association, 5530 Wisconsin Avenue, Washington, D. C. 20015, telephone 301/652-4420.

ANNUAL MEETING AMERICAN DRIED MILK INSTITUTE

The 49th Annual Meeting of the American Dry Milk Institute and the 3rd Annual Meeting of the Whey Products Institute will be held jointly at the Marriott Motor Hotel, Chicago, on April 17, 18 and 19, 1974, it has been announced by J. T. Walsh, Executive Director of both organization.

All dry milk and whey product manufacturers, allied industry friends interested in processing and marketing of these products, and representatives from government and universities are cordially invited to attend these meetings.

The general sessions programs will present informed speakers from industry, government, universities and the Institutes' staff who will discuss topics of current interest to the manufactured milk products industry, users and others utilizing dry milk and whey products.

As usual, an interesting program has been planned for ladies attending this joint annual meeting.

CENTRAL ATLANTIC STATES ASSOCIATION OF FOOD AND DRUG OFFICIALS

The 58th Annual Conference of the Central Atlantic States Association of Food and Drug Officials will be held at Host Farm, Lancaster, Pa. May 21-24, 1974. Attendance by non-members is welcomed. Program, registration and room information can be obtained from H. Thompson Price, Jr., Secretary-Treasurer, CASA, 900 Madison Avenue, Baltimore, Md. 21201.

ABA PRESIDENT ADDRESSES BEMA

Mr. Robert J. Wager, the newly-elected President and Chief Executive Officer of the American Bakers Association, addressed BEMA's Winter Meeting at the Pick-Congress Hotel, Sunday, March 3, 1974.

Mr. Wager, whose election was announced by ABA Chairman, Bill O. Mead the latter part of December, officially moved into the Washington, D. C. Headquarter Offices, January 21, 1974. Although he has been in command of the Industry's largest trade association for only a brief period of time, he has already demonstrated his ability and, it is predicted, that ABA is well underway to proving of even greater value to its members and furthering the best interest of the entire Baking Industry.

XIX INTERNATIONAL DAIRY CONGRESS New Delhi, India, December 2-6, 1974

The XIX International Dairy Congress will convene in New Delhi, India, December 2 to 6, 1974. The Congress sponsored by the International Dairy Federation with arrangements by the Indian National Dairy Development Board is open for attendance and participation by people interested in dairying from throughout the world.

A brochure issued by the Congress organizing committee describes the program as including a series of scientific and industry oriented sessions, international exhibitions to highlight progress in dairy development, international film and publications exhibitions, social functions, a ladies' program, and study tours. The technical program will emphasize four broad topics: Organizing for milk production; economic, technical, nutritional, and social impacts of dairying on developing areas; the task of dairy development; and structures for dairy development.

A limited supply of the brochures and entry forms for the film exhibition are available from the U. S. Liaison Officer, James W. Smith, USDA-ARS, Agricultural Research Center, Building 161, Beltsville, Maryland 20705.

DAIRY CONFERENCE PENNSYLVANIA STATE UNIVERSITY

A conference for dairy processing, quality control and sales personnel has been scheduled for April 8-11, 1974 at The Pennsylvania State University. It is conducted by the staff of the Food Science Department with the assistance of the Pennsylvania Department of Agriculture.

Primary emphasis is on shelf life, flavor and nutritional value of dairy products. Processing procedures, cleaning and sanitizing, refrigeration, frozen dessert mixes, waste disposal and sanitary regulations will also be covered.

For information contact: Agricultural Conference Coordinator, Room 410, J. O. Keller Building, The Pennsylvania State University, University Park, Pennsylvania 16802.

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Dairy authorities speak out on better cow milking

William L. Arledge
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Quality milk makes consumers happy and helps dairymen prosper.

Dairy farmers are unique. In most cases their primary source of income is their milk check. A major influence on that milk check is quality, and it has been shown that, as the quality of milk in a given market improves, so does consumer demand, and so does income to the dairy farmer.

High quality milk starts with the cow but it must be continued each step of the way until the milk is purchased and consumed.

TASTE MAKES FRIENDS

The nutritional value of milk to the human diet is never disputed. The relative dollar value of these nutrients, particularly protein in relation to other food costs, is also not disputed. However, consumers could care less about protein and nutritional value if the milk does not taste good due to poor quality control practices somewhere between the cow and the consumer. People simply will not buy poor quality milk.

Over 90% of consumer complaints are the result of post-pasteurization contamination and improper temperature control of the bottled product after pasteurization. This is dramatized by the fact that seven Grade A dairy plants recently increased the shelf life of their total packaged products from an average of 6 days to more than 21 days by improving in-plant controls over post-pasteurization contamination. Little or no change was made in the quality of the raw milk coming into the plant. (This shows that significant improvements can be made in dairy plants as well as on farms.)

REVIEW YOUR EFFORTS

Your role of producing quality milk daily can be as simple as you desire to make it.

It has been proven many times that it is cheaper to spend whatever is necessary to thoroughly clean your bulk tank, pipeline, or bucket milkers (all milk contact surfaces) than it is to do an improper job.

Follow these recommendations:

1. Read the label of your chlorinated cleaner detergent and *measure* the correct amount of water to be added to the correct amount of cleaner.
2. Be sure when circulating cleaning systems to start your wash cycle with 160° F. water and *stop* circulating when the temperature drops to 110° F. (If you don't, you will redeposit soil and fat.)
3. In colder areas, the use of a heating element in the wash tank is recommended to help maintain wash temperatures above 110° F., preferably 130-140° F. (Six to ten minutes is usually enough*).
4. Many dairy barns do not have hot water heaters that will deliver water at 160-180° F. and even if they do—the recovery of temperature in the heater is too slow and you end up trying to wash in lukewarm to cool water.
5. To prevent loss of *hot* water for cleanup, many dairymen install a second hot water heater and set the regulator at around 110-120° F. for use in hand washing of cows' teats and udders prior to milking as well as other manual cleaning chores. This leaves your other hot water heater available for the important job of cleaning equipment.
6. If you have an electric hot water heater, install fast recovery heating elements to prevent cool down of your hot water. For safety make sure all heaters are equipped with an approved *pressure* and *temperature* relief valve.
7. After thorough washing of equipment, rinse in an acid rinse and then immediately prior to milking always *sanitize* all milk contact surfaces with an approved sanitizer.

CARELESSNESS IS A LUXURY

As surprising as it may seem, we still find some people rinsing equipment with plain water after sanitizing. This causes great problems affecting milk quality since all water supplies contain from a few to large numbers of the "cold loving" psychrothrophic bacteria that can and do cause some very undesirable off-flavors in milk. Granted these organisms are killed by pasteurization but, by carelessness, dairymen can alter the flavor of milk prior to its leaving the farm by 1) lack of sanitizing, or 2) rinsing equipment rather than washing, or by 3) only rinsing a bulk tank.

Too many times we see dairymen doing a good job in their milking management practices, but disregarding their water supply, temperature of cleaning solutions and sanitization, thus nullifying all other good practices.

Quality of your *only* product affects *your only* income; your milk check. You can do more concerning the quality of your milk! Follow the routine and procedures you know to be correct and with these few quality tips, you may prevent the shipment of a tank of less-than-superior-quality milk.

We must all relate to the consumer. Do a quality job in your personal operation and expect the same throughout the chain of events to the consumer. You will reap the benefits through personal pride "all the way to the bank".

*Refer to local Health Department regulations