

# JOURNAL OF DAIRY SCIENCE

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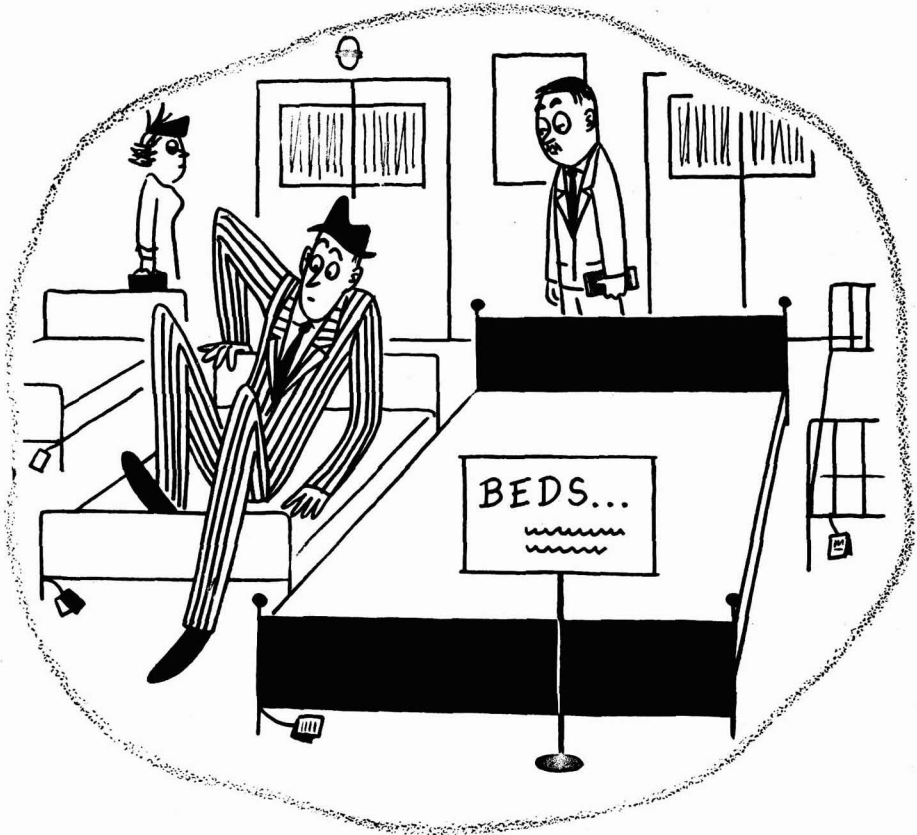
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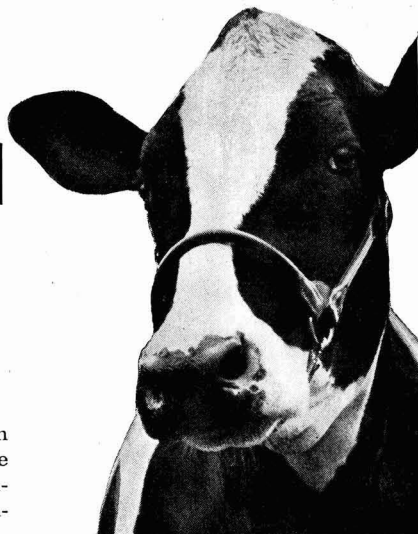
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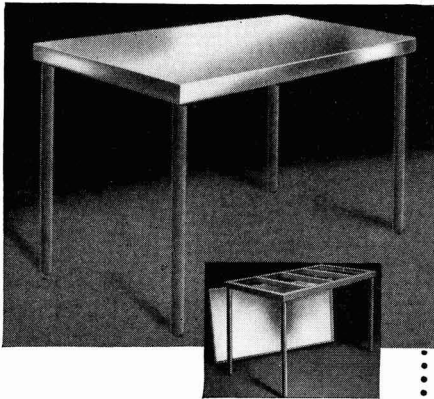
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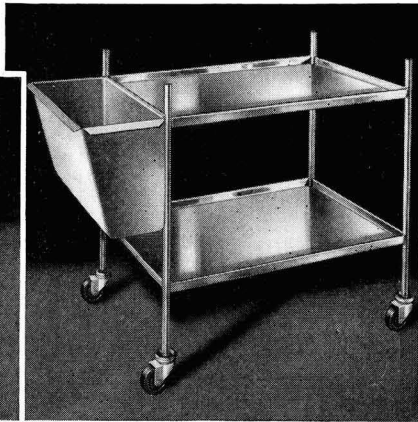
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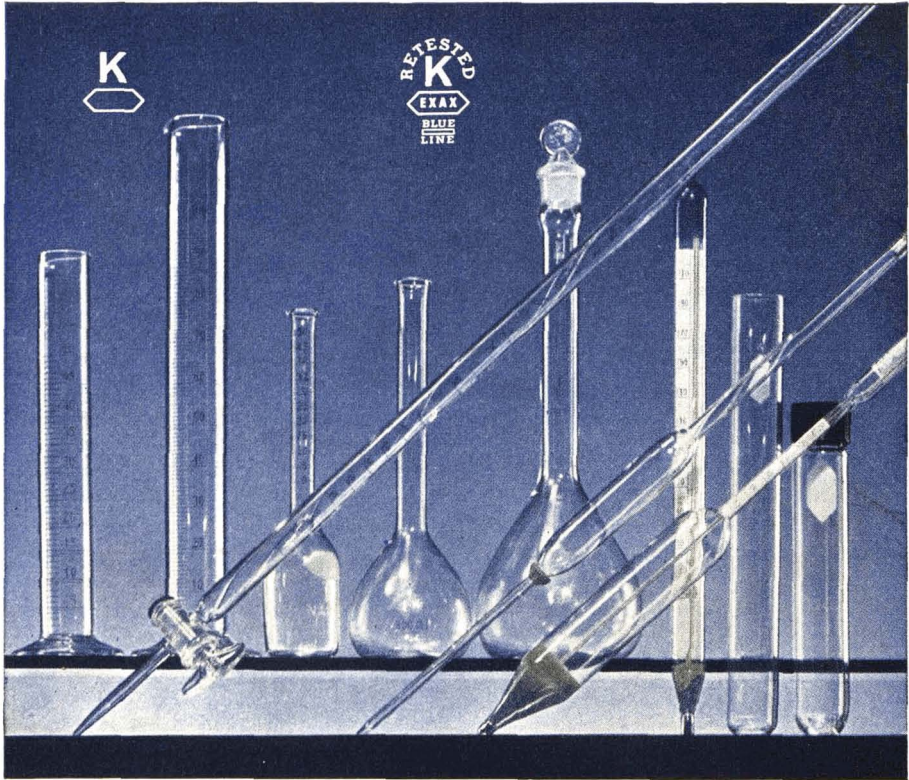
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# JOURNAL OF DAIRY SCIENCE

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## VARIOUS CARBOHYDRATES AS ENERGY SOURCES FOR SOME MIXED CULTURES OF SILAGE ORGANISMS<sup>1,2</sup>

R. L. SALSBURY,<sup>3</sup> R. E. MATHER AND C. B. BENDER  
*New Jersey Agricultural Experiment Station, Sussex*

Much of the work on the bacteriology of silage has been concerned with the isolation and identification of pure cultures of organisms which supposedly predominate in the silage and with the determination of total counts at various stages of the fermentation. For practical purposes, however, the primary interest is in the effect of the bacterial population of the silage, a population that is heterogeneous and may vary in composition with each silage made, and even from sample to sample, but which gives, ultimately, the same result in a large number of cases. Hence, a study using a mixed culture, which actually represents the bacterial population of the silage at the time each sample is taken, might furnish information which could not be supplied by work with pure cultures.

The desired effect in silage preservation is acid production by lactic acid bacteria from carbohydrates. The relative utilization of various carbohydrates, as measured by titration of the acid produced, is the basis for the classification of these organisms by Orla-Jensen (1). The pH attained by cultures also may be used to evaluate utilization of carbohydrates (2, 3).

The present experiment was designed to test the preference of the bacterial population, as it exists in the silo, for a number of carbohydrates. It was thought that a change in the predominating type of organism or in the carbohydrate available at a given time might be reflected in the degree to which the different carbohydrates were utilized under standard conditions.

### EXPERIMENTAL

Two silages, put up in 1946 and 1947, respectively, were used for this experiment. The material was chopped in the field and, in 1946, chopped again as it was being put into the silo. The crop ensiled in 1946 consisted of alfalfa, red clover and grass, to which was added about 70 lb. of molasses per ton of green material. In 1947 the crop ensiled was principally reed canary grass with a

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<sup>1</sup> Paper of the Journal Series—New Jersey Agricultural Experiment Station, Rutgers University—the State University of New Jersey, Department of Dairy Industry.

<sup>2</sup> This project was supported by a research grant from the Sugar Research Foundation, Inc., New York, N. Y.

<sup>3</sup> Present address: Michigan Department of Health, Lansing.

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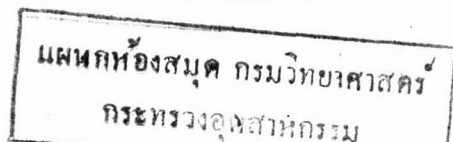


TABLE 1  
*Acidity and dry matter content of, and average production of acid (ml. 0.1 N acid), by mixed cultures from silage samples in 1946 and 1947 at various stages of fermentation*

D. in silo	1946					1947					
	Lower level		Upper level			Lower level		Upper level			
	pH	Dry matter (%)	Acid prodn. (ml.)	D. in silo	pH	Dry matter (%)	Acid prodn. (ml.)	D. in silo	pH	Dry matter (%)	Acid prodn. (ml.)
0	5.80	20.5	2.87	0	5.80	19.0	3.31	0	5.57	36.0	2.23
2	4.52	17.5	3.33	1	4.62	22.0	3.64	2	4.89	40.0	3.53
3	4.20	19.0	3.33	2	4.30	17.5	3.27	3	4.54	35.5	2.81
4	4.17	21.0	2.04	4	4.03	17.5	2.77	5	4.64	42.5	2.53
5	4.27	23.0	2.48	6	4.10	19.5	1.91	7	4.30	31.0	2.48
8	4.22	27.5	3.02	9	4.07	23.0	2.34				
10	4.42	28.0	2.37	12	4.18	23.0	2.59	11	4.11	33.5	2.30
13	4.26	28.0	2.31								
16	4.30	28.0	2.33	16	4.20	22.0	2.06	16	4.08	35.0	1.68
21	4.21	27.0	2.12	23	4.20	21.0	2.05	19	4.06	36.0	2.06
27	4.26	27.5	2.52					31	4.06	32.5	1.92
50	4.48	27.5	2.52	50	4.00	24.5	2.21	33	4.20	35.0	2.60

small amount of red clover. Molasses was added at the rate of approximately 180 lb. per ton of green material in the lower part of the silo; in the upper part, 100 lb. was added per ton. Samples of the mixture were taken from the surface just after it had been blown into the silo when the level reached the 10-ft. mark and again at the 20-ft. mark. Subsequent samples were obtained by drilling a hole in the wall of the silo, removing the sample and plugging the hole. The settling of the silage at each level was measured by means of a float connected by wire over pulleys with an indicating weight on the outside of the silo. Allowance for settling was made when boring the hole for sampling in an attempt to reduce variation which might be attributable to heterogeneous crop mixtures and molasses dispersion.

Determinations for pH were made with a Beckman pH meter on juice expressed from the silage by a small press. Dry matter determinations were made by the toluene distillation method.

For the bacteriological work, a 10-g. sample was placed in a 90-ml. sterile water blank. After being shaken, 1 ml. of this suspension was placed in a 99-ml. sterile water blank. Culture tubes containing 9 ml. of the differential media then were inoculated with 1-ml. portions of the final dilution. These were incubated for 4 days at 30° C. and the acid produced was titrated with 0.1 N NaOH, using phenolphthalein as the indicator. The titration value of the uninoculated medium was subtracted from the value obtained. The medium contained 0.5 per cent Difco yeast extract, 0.2 per cent potassium dihydrogen phosphate, 0.1 per cent magnesium sulfate, 0.04 per cent sodium chloride and 2.0 per cent carbohydrate. The carbohydrates used were xylose, arabinose, rhamnose, fructose, glucose, galactose, sucrose, lactose, raffinose, inulin, dextrin, soluble starch, glycerol, mannitol, sorbitol and salicin.

Analyses of variance and covariance were used to test the differences between crops, silo levels (and molasses addition levels) and among carbohydrates. Interrelationships among the carbohydrates, days after ensiling, pH and dry matter were studied by partial correlations calculated on a within carbohydrate, within year-level lot basis.

#### RESULTS AND DISCUSSION

*Acidity and dry matter.* The development of acidity (as measured by pH) and the dry matter content of the various samples of silage are illustrated in table 1, together with the acid production of the cultures in terms of ml. of 0.1 N acid as an average for all 16 carbohydrates. In all four lots the pH was reduced to 4.54 or less by the third day and 4.32 or less by the seventh day, indicating satisfactory acid development. The dry matter content of the silages was somewhat higher and the development of acidity a little slower in 1947 than in 1946, in spite of addition of more molasses in 1947. The average linear regression of pH on days in silo was significant, as indicated by the correlation  $-0.374$ , but the correlation between pH and log days was considerably higher ( $-0.729$ ). A prediction equation  $\text{pH} = 4.600 - 0.318 d'$  (where  $d' = \log$  days in silo) yielded estimated pH values for 0, 1, 2, 8 and 32 days of 5.24, 4.60, 4.50, 4.31 and 4.12, respectively.

The 1946 silage, with lower dry matter content and more legumes, had a sweeter odor and appeared to be more palatable and better than that of 1947.

*Fermentation studies.* The over-all mean values for the 16 carbohydrates studied (table 2) were shown to differ significantly by the analysis of variance. The differences between years and between levels were very small and not statistically significant, and the lack of a significant interaction between carbohydrate and year-level lot prevents the consideration of changes in differences between carbohydrates from one lot to another.

Correlation coefficients calculated within lot from the data of table 1 indicated no relationship between dry matter content of the sample and the amount of acid produced by the cultures.

TABLE 2

*Average amount of acid (as ml. 0.1 N acid) produced by mixed cultures of silage organisms after incubation for 4 days at 30° C. for each of 16 carbohydrates*

Group	Sugar	Ml. 0.1 N NaOH	Rank
Pentoses	Xylose	3.30	5
	Arabinose	4.68	1
Methyl pentose	Rhamnose	1.07	15
Hexoses	Fructose	3.47	4
	Glucose	4.05	2
	Galactose	2.46	8
Disaccharides	Sucrose	3.93	3
	Lactose	2.34	9
Trisaccharide	Raffinose	2.51	7
Polysaccharides	Inulin	1.69	12
	Dextrin	1.72	11
	Soluble starch	2.22	10
Alcohols	Glycerol	.88	16
	Mannitol	1.49	13
	Sorbitol	1.42	14
Glycoside	Salicin	3.04	6

The longer the material remained in the silo, the lower was the acid production of the cultures, as indicated by correlations of  $-0.438^{**}$  between mean acid production and days in silo and  $-0.451^{***}$  between logarithm of mean acid produced and log days. Thus the curvilinear relationship is very slight.

A correlation between mean and standard deviation indicated the desirability of transforming all acid production values to logarithms, but several negative values prevented the use of logarithms throughout. For six of the sugars, fructose, glucose, galactose, sucrose, lactose and raffinose, the within sugar within lot correlation between days in the silo and log acid production was  $-0.229^{**}$  (191 degrees of freedom). Similarly, the within sugar within lot correlation for these six sugars between pH and log acid production was  $0.238^{**}$ .

Simple correlation coefficients among the acid production values of the six sugars previously mentioned and the correlation of these values with days in the

<sup>4</sup> Throughout this paper \* represents significance at the 5 per cent point and \*\* represents significance at the 1 per cent point.

silage and with pH of the silage sample are presented in table 3. In general, the correlations are not high, but five are highly significant. The general activity of the cultures, as related to days in the silage and to the pH of the silage samples, undoubtedly would influence the size of the correlations among the acid production values of the six sugars. Partial correlation coefficients, independent of these two relationships and also independent of fluctuations in the most closely related sugars, were lower than most of the values of table 3, but in other cases very different relationships appeared. The most pronounced change in correlation was observed in the relationships between glucose and raffinose where the simple correlation was  $-0.198$ ; when independent of fluctuations associated with days in the silage and fructose and galactose, the correlation was  $-0.588^{**}$  but when independent of pH, fructose and galactose it was only  $-0.051$ .

These results, though based on rather limited data, indicate that there is comparatively little systematic change in the preference of the mixed cultures of silage organisms as the fermentation progresses, while there is a definite decrease in the amount of acid produced by the mixed cultures the longer the silage has been fermenting, which undoubtedly is a function of the number of viable organisms present.

TABLE 3  
*Correlation coefficients among acid production values (logarithms) of six sugars, age of silage and pH of silage, within lot*

	Fructose 4	Glucose 5	Galactose 6	Sucrose 7	Lactose 8	Raffinose 9
d Days	-0.033	-0.242	-0.200	-0.215	-0.451**	-0.151
p pH	0.210	0.299	0.211	0.329	0.295	0.156
4 Fructose		0.300	0.657**	0.621**		0.246
5 Glucose			0.573**	0.399*	0.048	-0.198
6 Galactose					0.042	0.382*
7 Sucrose					0.153	0.354*
8 Lactose						0.506**

The most desirable carbohydrates for silage preservation from the standpoint of rapid acid production would seem to be arabinose, glucose, sucrose, fructose and xylose. However, it must be kept in mind that since molasses was used as a preservative for the silage studied here, the organisms which developed most rapidly undoubtedly were the ones which could utilize the sugars of molasses most efficiently. The polysaccharides produced less acid than the sugars, indicating one reason why greater quantities of cereal grains than molasses may be required for silage preservation. Likewise, the comparatively low acid production of lactose explains why dried whey is a less desirable preservative than molasses.

In addition to consideration of the various carbohydrates as preservative materials to add to silage, these results reemphasize the importance of ensiling a crop when it is high in simple sugars, rather than when it becomes so mature that a large proportion of the carbohydrates in the plant are present as polysaccharides. In some cases, of course, this is counterbalanced by the much larger total amount of carbohydrate present in more mature plants.

## SUMMARY AND CONCLUSIONS

A study was made to determine the relative amounts of acid produced by mixed cultures of silage organisms when offered various carbohydrates as sources of energy.

As the silage aged, the viability of the cultures was somewhat reduced, though considerable variation was observed with some carbohydrates. This decrease did not follow the pH of the silage samples much more closely than it followed a simple linear decline with age.

Interrelationships among six sugars, in terms of fluctuations of the logarithms of acid production about the mean or regression on age or on pH of the silage, showed that adjustment for pH of the sample reduced most correlations, though correlations between variations of glucose and galactose, fructose and galactose, and sucrose and levulose independent of glucose remained highly significant.

Arabinose, glucose, sucrose, fructose and xylose resulted in the production of more acid than the other carbohydrates used. There were no significant changes in acid production in the 2 years studied even though the nature of the crop and the amount of molasses added as a preservative changed considerably.

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## THE NUTRITIVE VALUE OF WOOD MOLASSES AS COMPARED WITH CANE MOLASSES<sup>1</sup>

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One of the many objectives of the Forest Products Laboratory of the U. S. Forest Service at Madison, Wis., is to find and develop new uses for low quality wood and wood wastes. One such development of this laboratory is the production of wood molasses.

Using a dilute acid process for hydrolysis similar to one used in Germany with many modifications as reported by Harris (6), yields of 130 to 200 gallons of molasses containing 50 per cent sugar are obtained from each ton of wood. The process consists of hydrolyzing the cellulose of waste wood to form glucose by means of dilute sulfuric acid and increased temperature and pressure. After neutralization, the resulting solution is concentrated to form molasses.

Although wood molasses has many potential uses in industry, it also has very important possibilities as a feed for livestock. Molasses made from wood was fed to farm animals as early as World War 1. It was tested experimentally as a feed for livestock in Germany and certain Scandinavian countries during the recent war. While wood molasses has been reported to be an acceptable feed for livestock as a result of preliminary feeding trials conducted in this country (7), few quantitative measurements appear to have been made with farm animals to determine its nutritive value.

Because wood molasses might be used in livestock feeding in the same manner as cane molasses and because the nutritive properties of this latter product are very well known, these two products were compared by means of balance experiments with dairy heifers.

### EXPERIMENTAL

The wood molasses fed in this experiment was made from pine wood wastes at the Forest Products Laboratory, Madison, Wis. It was compared with cane molasses purchased from a local feed store. The hay with which the molasses was fed was a field-cured grass-legume mixture from a lot part of which had been fed as the sole ration in unreported nitrogen and energy balance experiments.

The animals used in all of the balance experiments were purebred dairy heifers weighing between 630 and 900 lb. at the beginning of the experiment and included four Guernseys, one Ayrshire and one Holstein. Each animal was fed a daily basal maintenance ration of 6 kg. of hay on all balances with the exception of one small heifer, no. 6, which received 5 kg. Two kg. of wood molasses or its energy equivalent of cane molasses were added to the basal hay ration of each animal in

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the molasses balances with the exception of heifer no. 6, where the amount of molasses fed was reduced in proportion to the hay. All of the balances were carried out between October 13, 1948, and March 12, 1949, with the animals being allotted to the various rations according to table 1.

The procedure and methods followed in this experiment were essentially the same as those used in previous research reported from this laboratory (2), with some modifications described in a recent paper (4). The molasses was mixed thoroughly with the chopped hay before feeding. Because of the lumpiness of the wood molasses, a daily aliquot was taken for each animal during the collection period to insure a representative sample. However, the method of production has been perfected recently so that wood molasses of uniform consistency can be produced. The cane molasses was more homogeneous so a representative sample was taken from the drum after thorough mixing. The molasses samples were analyzed in triplicate for both nitrogen and gross energy, the samples used for the gross energy determination first having been dried in the capsules under vacuum.

TABLE 1  
*Schedule of balance experiments*

Heifer no.	Breed	Hay balances	First molasses balance	Second molasses balance
1	Guernsey	Hay		
2	Guernsey	Hay	Hay + wood molasses	
4	Holstein	Hay	Hay + cane molasses	Hay + wood molasses
3	Guernsey		Hay + wood molasses	Hay + cane molasses
5	Ayrshire		Hay + cane molasses	Hay + wood molasses
6	Guernsey		Hay + wood molasses	Hay + cane molasses

The preliminary feeding periods were of about 7 days duration, while the collection periods were from 14 to 18 days in length. Three consecutive 12-hr. heat production measurements were made at the end of each collection period by means of the open circuit respiration chamber.

#### RESULTS AND DISCUSSION

The nitrogen content of the wood molasses calculated as protein was 0.44 per cent while that of the cane molasses was 2.83 per cent. The gross energy on the other hand was higher in the wood molasses. This necessitated feeding a little more cane molasses in order to have the intake of energy the same from both kinds of molasses.

The protein and energy contents of the hay, cane molasses and the individual composite samples of wood molasses are given in table 2. Summaries of the nitrogen balances are given in table 3, energy balances in table 4 and metabolizable energy values in table 5.

Although it was desired to feed the basal ration of hay at as near the maintenance level as possible, a little extra was fed in order to avoid the possibility of submaintenance feeding of the growing heifers. This resulted in an average gain of 8.109 g. of nitrogen and 821 Calories of energy per day on the hay ration. The

retention of nitrogen was increased when both the molasses supplements were fed, even though in the case of the wood molasses relatively little additional nitrogen was ingested. This effect appears to have been due to an inadequate energy intake from non-nitrogenous sources on the basal hay ration. Digestibility of nitrogen, on the other hand, was depressed with the addition of both the wood and cane molasses to the hay. The apparent digestibility of the nitrogen in the wood molasses-plus-hay ration was 12.1 per cent less than that of hay alone. The addition of the cane molasses to the hay lowered the apparent digestibility of the nitrogen by 4.8 per cent.

While there are no reports in the literature on the effect of wood molasses on the apparent digestibility of the ration, Lindsey and Smith (9), Williams (10), Briggs and Heller (3), Hamilton (5), as well as others, found that the addition of cane molasses to the ration lowered the apparent digestibility of the nitrogen to varying degrees. The probable explanation for this decrease is that the increased dry matter intake resulted in a higher metabolic nitrogen excretion. This explanation is supported by the work of Armsby (1), and of Harris and Mitchell

TABLE 2  
*Composition of feeds*

Feed	Moisture	Protein	Gross energy
	(%)	(%)	(Cal./g. D.M.)
Hay	9.19	10.644	4.3102
Cane molasses	26.86	2.825	3.6608
Wood molasses fed to:			
Heifer 2	23.67	0.369	3.8793
Heifer 3	23.89	0.288	3.9761
Heifer 4	25.82	0.406	4.0358
Heifer 5	27.10	0.519	4.0561
Heifer 6	26.42	0.613	4.0204
Av.	25.38	0.439	3.9935

(8), which showed that when molasses was added to nitrogen-free rations being fed to sheep, there was an increase in the metabolic nitrogen. Using the factor of 5.5 mg. for metabolic nitrogen in the feces per gram of dry food consumed, as worked out by Harris and Mitchell (8), the average true digestibilities of the protein of the basal hay ration, the wood molasses-plus-hay and the cane molasses-plus-hay rations are essentially the same, being 82.4, 79.4, and 83.0 per cent, respectively. Thus, the significantly lower apparent digestibility of the nitrogen in the two molasses-plus-hay rations, as compared with that of the basal hay ration, is almost entirely accounted for by the increase in fecal nitrogen resulting from the higher dry matter intake.

The retention of energy was increased markedly when both the wood and cane molasses supplements were fed. The average digestibility of the energy increased 2.4 and 3.2 per cent, respectively, when the wood and the cane molasses were fed, but this difference was not significant. The metabolizable energy increased about the same amount when both the wood and cane molasses were added to the hay ration. The metabolizability percentage of the two molasses rations was essentially the same and not significantly higher than that of the basal hay ration.

TABLE 3  
Average daily nitrogen balances

Ration	Hay				Hay + wood molasses						Hay + cane molasses					
	1	2	4	6	1	2	3	4	5	6	1	2	3	4	5	6
Heifer no.																
Body weight (lb.)	690	715	715		729	724	724	798	908	631	745	763	872	645		
Intake (g.)	102.180	102.180	102.180		93.272	100.445	103.480	103.480	103.840	86.777	112.124	112.124	112.124	94.190		
Outgo (g.)																
Feces	48.735	47.178	47.736		54.743	56.997	61.904	61.241	61.241	52.644	58.607	57.619	56.469	49.551		
Urine	49.301	43.334	45.975		34.888	23.868	31.299	33.262	21.658	42.943	42.943	32.984	48.342	27.922		
Total	98.036	90.512	93.711		89.631	80.865	93.203	94.503	82.893	74.302	101.550	90.603	114.811	77.473		
Balance (g.)	+4.144	+11.668	+8.469		+13.729	+19.580	+10.277	+9.337	+9.337	+12.475	+10.574	+21.521	+7.313	+16.717		
Digestibility (%)	52.30	53.83	53.28		41.31	43.25	40.18	41.02	39.34	47.73	48.60	49.64	47.39			
Average balances (g.)		8.09				13.09						14.03				
Average digestibility <sup>a</sup>		53.14				41.02						48.34				

<sup>a</sup> All differences are significant at the 1 per cent level.

TABLE 4  
Average daily energy balances

Ration	Hay						Hay + wood molasses						Hay + cane molasses									
	1	2	4	2	3	4	2	3	4	5	6	2	3	4	5	6	2	3	4	5	6	
Heifer no.	690	715	715	739	724	798	908	908	908	908	631	745	763	872	645		29376	29376	29376	29376	29376	24925
Body weight (lb.)	23485	23485	23485	29407	29557	29473	29399	24481														
Intake (Cal.)	9085	9590	9901	11097	11267	11109	11169	9740														
Outgo (Cal.)	933	817	826	1041	813	1029	1008	753														
Feces	1507	1332	1452	1709	1900	1899	1731	1453														
Urine	10802	11442	10304	13125	11494	12086	12791	9995														
Methane	22327	23181	22483	26972	25474	26123	26689	21941														
Heat production	+ 1158	+ 304	+ 1002	+ 2435	+ 4063	+ 3350	+ 2700	+ 2540														
Total	61.3	59.2	57.8	62.3	61.9	62.3	62.0	60.2														
Balance (Cal.)																						
Digestibility (%)																						
Average energy balances (Cal.)		821				3050																
Average digestibility <sup>a</sup>		59.4				61.8																

<sup>a</sup> Differences in digestibility are not significant.

TABLE 5  
Average daily metabolizable energy

Ration	Hay						Hay + wood molasses						Hay + cane molasses					
	1	2	4	2	3	4	5	6	3	4	5	6	3	4	5	6		
Heifer no.																		
Body weight (lb.)	690	715	715	739	724	798	908	631	745	763	872	645	745	763	872	645		
Dry matter consumed ( $\rho$ .)	5449	5449	5449	6973	6971	6933	6907	5762	7058	7058	7058	6003	7058	7058	7058	6003		
Gross energy (Cal.)	23485	23485	23485	29407	29537	29473	29399	24481	29376	29376	29376	24925	29376	29376	29376	24925		
Metabolizable energy (Cal.)	11939	11659	11243	15458	15411	15359	15421	12423	15885	15069	15486	13365	15885	15069	15486	13365		
Metabolizable energy/ g. dry matter (Cal.)	2.191	2.140	2.063	2.217	2.211	2.215	2.233	2.329	2.251	2.135	2.194	2.226	2.251	2.135	2.194	2.226		
Metabolizability (%)	50.8	49.6	47.9	52.6	52.2	52.1	52.5	50.7	54.1	51.3	52.7	53.6	54.1	51.3	52.7	53.6		
Average metabolizable energy/g. dry matter (Cal.)																		
Average metabolizability <sup>a</sup>																		

<sup>a</sup> Differences in metabolizability percentage are not significant.

When calculated by difference, the metabolizable energy values, expressed as Cal. per g. dry matter, were found to be 2.537 for the wood molasses and 2.403 for the cane molasses.

#### SUMMARY AND CONCLUSIONS

The nutritive value of wood molasses was compared with cane molasses by means of 12 protein and energy digestion balance experiments with dairy heifers. Both the cane and wood molasses contained very little protein although the cane molasses contained 7 times more protein than the wood molasses. The wood molasses excelled the cane molasses in gross energy content by about 10 per cent on the dry basis.

The apparent digestibility of the protein in the ration was depressed when both the cane and wood molasses were added to the basal hay ration. When cane molasses was added, the decrease was 4.8 per cent, while with the addition of the wood molasses the digestibility of the protein was decreased by 12.1 per cent. However, almost all of this effect can be accounted for on the basis of increased metabolic nitrogen excretion in the feces. The digestibility as well as metabolizability of the energy was greater when both the wood and cane molasses were added to the basal hay ration but the differences were not significant. The metabolizable energy per gram of dry matter was essentially the same in both molasses.

The results of this experiment indicate that wood molasses is comparable to cane molasses as a feed for dairy cattle.

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# THE EFFECT OF VACCINATION WITH BRUCELLA ABORTUS VACCINE (STRAIN 19) ON CERTAIN BLOOD CONSTITUENTS IN YOUNG HEIFERS<sup>1</sup>

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The development in young calves of immunity to *Brucella abortus* by the use of vaccination with an avirulent *B. abortus* organism (strain 19) has been observed to cause, in some instances, a loss of appetite. This may result in temporary loss of body weight if it persists. This observation has been noted with calves in the University herd. In addition, during the course of an experiment in which blood levels of vitamin A and ascorbic acid were being followed, vaccination had a material effect on these levels. This led to the present study in which the course of change in blood plasma vitamins as well as temperature, body weight, condition of calves and leucocyte differential were noted.

## METHODS

The procedure consisted of recording daily blood plasma levels of vitamin A, ascorbic acid, temperature, body weight and condition of the calves. This was begun 1 day before and continued for 7 days after inoculation. Observations on leucocyte count and differential (Wright stain) were made on the day before and the first, third and fifth days following inoculation. The inoculum consisted of an injection of 5 ml. of a solution containing 10 billion organisms per ml.

Ten heifer calves which were to be vaccinated were placed under observation. These calves, seven Holsteins, two Jerseys and one Guernsey, were divided into four lots as follows: lot I received 0.5 g. ascorbic acid subcutaneously; lot II were the untreated controls; lot III received approximately 6,000 $\gamma$  vitamin A orally and 0.5 g. vitamin C subcutaneously; and lot IV received a supplement of approximately 6,000 $\gamma$  vitamin A orally. The supplements in lots I, III and IV were begun the day before inoculation and continued for 7 days thereafter.

The plasma ascorbic acid was determined by the method of Mindlin and Butler (4) and vitamin A by Kimble's method (3).

With the exception of the supplements, treatment consisted of the usual care and feed given calves in the University herd. The pertinent data concerning these calves at the beginning of this study are given in table I.

## RESULTS

The results (table 2) indicate that vaccination with *B. abortus* vaccine (strain 19) caused a decrease in blood plasma ascorbic acid averaging 0.18 mg. per 100 ml. in the four lots. This decrease was apparent on the day following inoculation.

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TABLE 1  
History of experimental animals

Lot no.	Breed	Age at beginning of exp.	Condition	Previous history regarding Bang's disease
		(d.)		
I				
338	H	215	Normal	Not known
342	H	193	Normal	Not known
II				
334	H	241	Normal	Not known
343	H	157	Normal	Positive reaction in 1: 200 dil. at 77 d.*
729	J	209	Normal	Not known
III				
340	H	202	Normal	Not known
582	G	237	Normal	Not known
731	J	150	Growth somewhat retarded	Positive reaction in 1: 200 dil. at 70 d.*
IV				
336	H	231	Normal	Not known
341	H	202	Normal	Not known

\* Had nursed infected cow from birth.

When vitamin C was administered subcutaneously in lots I and III, a drop of the same magnitude occurred, but normal levels of blood plasma ascorbic acid were attained again in less than 7 days. In contrast, the blood plasma ascorbic acid injections, did not reach normal levels within this period.

Blood plasma vitamin A also was affected by this vaccination. The decrease, which amounts on the average to 3.0 $\gamma$  per 100 ml., was greatest on the second day following inoculation rather than on the first, as was the case with ascorbic acid.

TABLE 2  
The effect of calfhood vaccination on average blood plasma ascorbic acid, vitamin A and carotene levels, and rectal temperature

Lot no.	Days before and after inoculation								
	-1	0	1	2	3	4	5	6	7
	mg. ascorbic acid/100 ml. blood plasma								
I	0.37	0.49	0.31	0.34	0.32	0.34	0.35	0.40	0.38
II	0.50	0.46	0.26	0.24	0.24	0.26	0.27	0.32	0.34
III	0.52	0.61	0.40	0.49	0.36	0.48	0.49	0.48	0.50
IV	0.38	0.38	0.26	0.23	0.16	0.23	0.23	0.26	0.29
	$\gamma$ Vitamin A/100 ml. blood plasma								
I	16		14	12	14	13	14	16	16
II	15		14	11	12	13	13	15	17
III	16		18	15	16	18	20	21	21
IV	18		19	16	17	18	20	21	21
	Rectal temperature ( $^{\circ}$ F.)								
I	102.2	101.8	105.4	105.9	105.1	103.2	101.6	101.8	101.6
II	102.1	102.2	105.2	105.2	104.0	102.8	101.7	102.1	101.4
III	101.9	101.6	104.7	104.8	103.8	103.0	102.3	102.1	101.7
IV	101.8	101.6	105.4	104.6	104.8	103.1	101.8	102.0	101.5

TABLE 3  
The effect of calfhood vaccination on total and differential leucocyte counts

Lot and number	Days before and after treatment															
	-1				+1				+3				+5			
	Leucocyte count (mm. <sup>3</sup> )	Lymphocytes (%)	Neutrophils (%)	Monocytes (%)	Eosinophils (%)	Leucocyte count (1 mm. <sup>3</sup> )	Lymphocytes (%)	Neutrophils (%)	Monocytes (%)	Eosinophils (%)	Leucocyte count (1 mm. <sup>3</sup> )	Lymphocytes (%)	Neutrophils (%)	Monocytes (%)	Eosinophils (%)	
I																
338	10,500	77	19	2	2	14,200	34	57	8	1	12,900	27	73	—	10,800	
342	8,900	65	17	7	11	9,200	61	34	3	2	9,400	71	8	20	8,500	
Av.	9,700	71	18	5	7	11,700	48	46	6	2	11,150	49	41	10	9,650	
II																
334	10,400	68.5	21	9	0.5	12,500	40	50	9	1	13,300	77	21	1	11,400	
343 <sup>a</sup>	10,200	61	26	6.5	6.5	15,200	30	53	14	3	12,300	64	21	14	8,200	
729	7,700	81	15	3	1	10,000	33	60	5	2	7,900	65	24	11	7,200	
Av.	9,433	70.5	21	6.2	2.7	12,566	34	54	9	2	11,170	69	22	9	8,933	
III																
340	8,300	67	17	15	1	9,100	47	52	1	—	7,100	63	22	14	6,300	
582	10,100	82	11	6.7	0.3	9,200	42	47	10	1	7,500	69	13	18	8,700	
731 <sup>a</sup>	6,900	71	12	15	2	13,400	42	54	23	1	11,000	68	23	8	8,700	
Av.	8,433	73	13	12.2	1.1	10,566	44	51	11	1	8,533	67	19	13	7,900	
IV																
336	9,800	58	26	14	2	11,700	44	45	10	1	10,800	72	21	5	8,500	
341	6,900	70	15	13	2	10,700	42	50	7	1	9,200	70	19	11	7,700	
Av.	8,350	64	21	14	2	11,200	43	48	9	1	10,000	71	20	8	8,100	

<sup>a</sup> These calves were known to have had a positive reaction in 1:200 dil. at 77 and 70 d. respectively.

Calves which received vitamin A supplements responded in the same way as those which received no supplement, except that blood concentrations were maintained at a higher level.

The calves showed no significant change in weight during the course of this study. This was in contrast to that noted in the preliminary observation mentioned above. Inappetence was observed only on the day following inoculation, with a complete return to normal on the third day.

The rectal temperature showed an average rise of 3.4° F. on the first day following inoculation. This higher temperature was apparent for 2 days, after which it receded, reaching normal levels by the fifth day. There was no difference in the course of temperature rise among the calves of the various lots.

The leucocyte count showed a distinct rise on the first day following inoculation in all but one calf and returned to normal by the fifth day (table 3). The leucocyte count of calves 338, 334, 343 and 731 reached somewhat higher levels than for the remaining six calves. Two of these, 343 and 731, were known to have had a positive reaction to *B. abortus* previously. No such information was available on the remaining calves.

The lymphocytes decreased from an average of 70.05 per cent to 41.50 per cent and neutrophils increased from an average of 17.90 per cent to 50.2 per cent on the day following inoculation. These, likewise, had returned to near normal levels by the fifth day. The monocytes and eosinophiles were affected only slightly.

#### DISCUSSION

The results of this study indicate that vaccination with *B. abortus* vaccine (strain 19) has a depressing effect on blood plasma levels of vitamin A and C. The ascorbic acid does not reach normal levels during the first week following vaccination. Since this vaccination generally is practiced when calves are 5 to 8 months of age, and normal blood plasma vitamin C levels are in the neighborhood of 0.4 to 0.6 mg. per 100 ml., it seems logical to assume that no detrimental effect will result from the temporary lower levels, which in these calves range from 0.16 to 0.24 mg. per 100 ml. This might not be true if calves were deficient at the time of inoculation. The drop in blood plasma vitamin A observed in these calves was consistent but not marked, and the data do not indicate that deficient levels were reached. Supplementation of the normal diet with either ascorbic acid or vitamin A did not alter the course of blood plasma levels, except to maintain higher concentrations.

The rise in rectal temperature follows closely the drop which occurred in blood plasma ascorbic acid. A drop in the concentration of blood plasma ascorbic acid apparently correlates closely with the development of an increased body temperature.

The leucocyte count is of interest since two of the four calves which reached counts above the rest were known to have had a previous positive reaction. The question is raised as to whether the two calves with higher leucocyte counts, but on which no titre had been determined previously, had a positive reaction at some

earlier date. These data, although from limited numbers, definitely demonstrate a rise in leucocyte count immediately following the vaccination. This average is transitory, since levels approximating normal values are reached in a matter of a few days. The reports by Bell and Irwin (1) and Irwin and Bell (2) do not indicate a rise in adult animals during an infection with *B. abortus*. However, their data are averages based on longer time intervals, and do not emphasize the fluctuations in leucocytes immediately following the infection.

#### SUMMARY

These studies show that blood plasma vitamin C and A levels are reduced by vaccination with *B. abortus* vaccine (strain 19). The vitamin C levels do not return completely to normal after 1 wk. as do the vitamin A levels. Vitamin C or A in addition to the normal diet had no effect on the course of blood plasma levels, except to maintain them above that for calves not receiving the supplement.

A rise in rectal temperatures followed closely the drop in blood plasma vitamin C and may suggest a relationship between the increase in body temperature and a lowering of blood plasma ascorbic acid.

Leucocyte count increased the day following inoculation. Differential count showed that the neutrophils increased, the lymphocytes decreased, and the monocytes and eosinophiles slightly increased and decreased, respectively, by this type of vaccination.

#### ACKNOWLEDGMENT

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## PREPARTUM MILKING. II. THE EFFECT OF PREPARTUM MILKING ON THE CAROTENE AND VITAMIN A AND PROXIMATE COMPOSITION OF COLOSTRUM<sup>1</sup>

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Prepartum milking for 10 days prior to parturition has been found by several investigators (4, 7, 11, 12, 13) to result in the production of colostrum which resembles milk in proximate composition. In addition, the proportion of various proteins, albumin, casein and globulin are altered markedly. The carotene content of colostrum from cows milked prepartum has been found (6) to rise on the day of parturition. No data were found in the literature as to the effect of prepartum milking on the vitamin A content of colostrum.

The objectives of this study were (a) to determine the effect of prepartum milking for 10 days prior to the calculated parturition date on the carotene, vitamin A and proximate composition of colostrum, and (b) to follow the changes occurring in the carotene and vitamin A content of the pre-milk and colostrum of cows milked prepartum. Secondarily, these factors were studied in relation to two dietary regimes.

### EXPERIMENTAL

*Animals.* A total of 44 cows of the Ayrshire, Guernsey, Holstein and Jersey breeds in the University of Connecticut herd which calved from November, 1947, through December, 1948, were used in this experiment. The treatment of these cows and changes in various blood constituents have been described in the first paper of this series (3). Briefly, they represented four experimental groups: 1-A, postpartum milked—basal ration; 1-B, postpartum milked—basal ration plus 1 million USP units of vitamin A daily for 30 days prior to the calculated parturition date; 2-A, prepartum milked for 10 days prior to calculated parturition date—basal ration; and 2-B, prepartum milked—basal ration plus vitamin A. Each experimental group in this study represented a total of 11 cows.

*Samples and Analyses.* All prepartum milkings and the first six postpartum milkings were sampled. The samples were chilled immediately and held at 4° C. in the dark until analyzed, in most cases within 6 days after collection. Aliquot samples from daily prepartum milkings and from each milking postpartum were analyzed for carotene, vitamin A, protein, lactose, fat and ash. In addition, specific gravity was determined. The methods were the same as those reported previously (2). In cases where the cows milked prepartum calved between the morning and evening milkings, the morning sample was analyzed separately.

Standard statistical procedures (9), such as analysis of variance, were used to test for differences between treatments.

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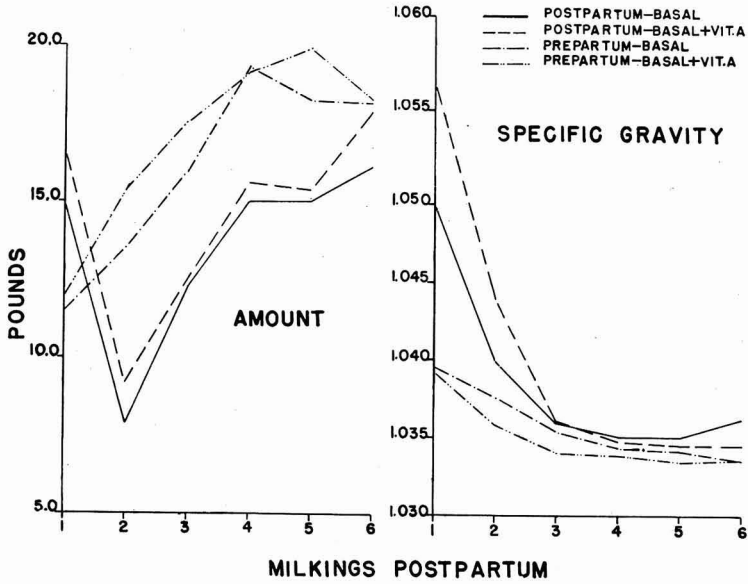


FIG. 1. The effect of prepartum milking on the amount and specific gravity of colostrum.

RESULTS

Data on the pounds of colostrum, the specific gravity, and the carotene, vitamin A and proximate composition for the first six milkings postpartum of all

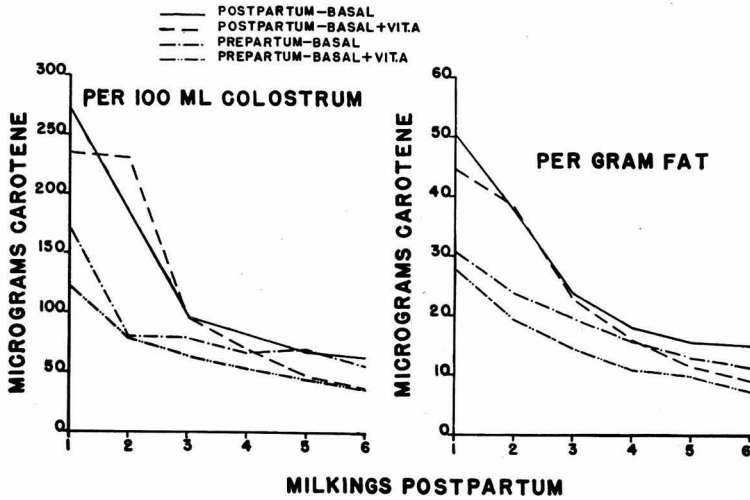


FIG. 2. The effect of prepartum milking on the carotene content of colostrum.

the experimental animals are given in figures 1, 2, 3 and 4. Mean values for the carotene and vitamin A contents of the pre-milk and colostrum for the 14 cows milked 10 or more days prepartum are represented in figures 5 and 6. In general, prepartum milking resulted in colostrum which was lower in carotene, vitamin A, protein and ash and higher in lactose than colostrum from cows milked only postpartum. In those cows milked prepartum for 10 days or longer and fed only the basal ration, there was a negative trend in the carotene and vitamin A contents of both pre-milk and colostrum. Parturition appeared to arrest temporarily this negative trend. Supplementary prepartum feeding of vitamin A raised the level of vitamin A in both the pre-milk and the colostrum and lowered the level of carotene in the colostrum.

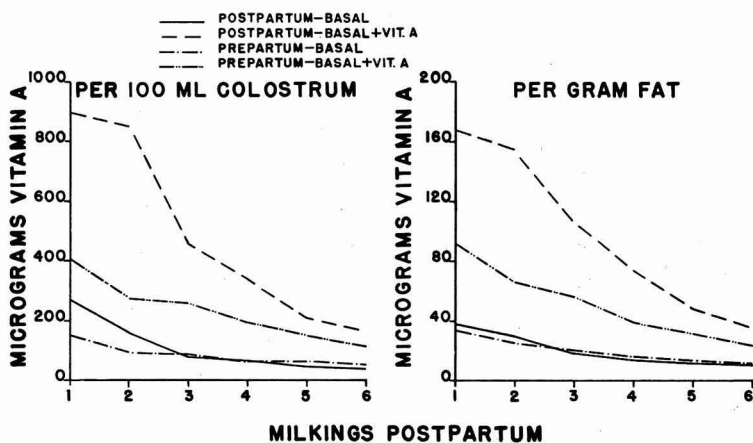


FIG. 3. The effect of prepartum milking on the vitamin A content of colostrum.

With the exception of the first milking postpartum, the average amount of colostrum (fig. 1) from the next five milkings was significantly less in the cows milked only postpartum ( $P < 0.05$ ). It was observed at the second milking of many of the cows milked only postpartum that there was incomplete "let-down" of milk. The specific gravity of the colostrum averaged less ( $P < 0.001$ ) in the first six milkings postpartum of those cows which had been milked prepartum than in those that had not.

The carotene content (fig. 2) per 100 ml. of colostrum or per gram of colostrum fat averaged less ( $P < 0.05$  on a volumetric basis and  $P < 0.10$  on a per gram of fat basis) in the cows milked prepartum. The average carotene levels were less following the prepartum feeding of vitamin A supplements, but the difference was not significant. The vitamin A content expressed as micrograms per 100 ml. of colostrum or as micrograms per gram of colostrum fat (fig. 3) also averaged less ( $P < 0.01$ ) in the cows milked prepartum. The prepartum feeding of vitamin A supplements increased the average level of vitamin A in the

colostrum very significantly ( $P < 0.001$ ). This increase was large enough to more than offset the usual reduction in the vitamin A content of the colostrum due to prepartum milking ( $P < 0.01$ ).

The average protein and ash contents of the colostrum were lower ( $P < 0.001$  for the protein and  $P < 0.01$  for the ash) and the average lactose content higher

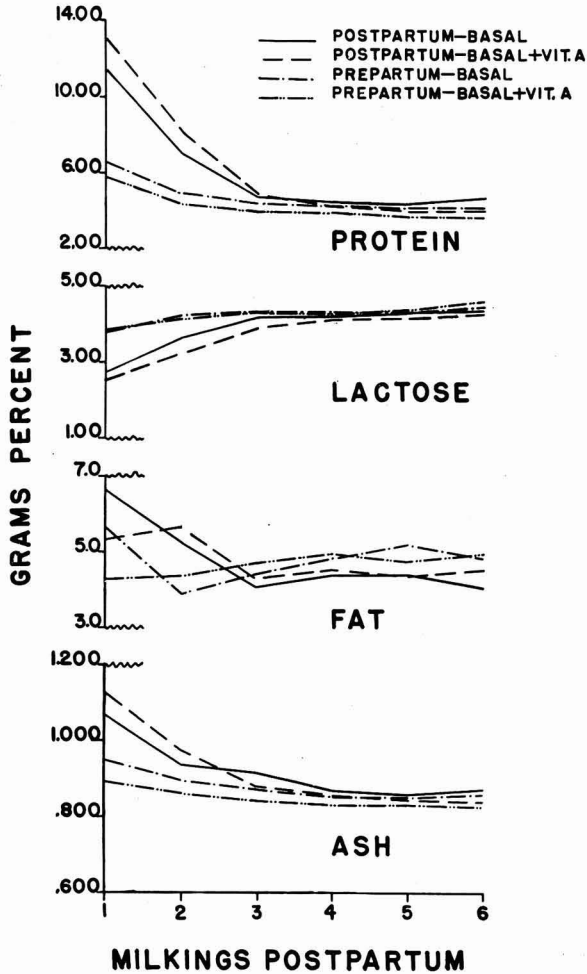


FIG. 4. The effect of prepartum milking on the proximate constituents of colostrum.

( $P < 0.001$ ) (fig. 4) as a result of prepartum milking, but the average fat content was not affected significantly. The feeding of supplementary vitamin A did not influence the proximate constituents.



The carotene and vitamin A content of both pre-milk and colostrum (fig. 5 and 6) decreased with successive milkings.<sup>2</sup> The decrease in animals receiving only the basal ration was statistically significant when the carotene and vitamin A contents were expressed in units per gram of colostrum fat ( $P < 0.01$ ). The greater variability among the cows receiving the supplementary vitamin A reduced the statistical significance of the change considerably, even when vitamin A content was expressed in terms of the colostrum fat ( $P < 0.05$ ). Just prior to parturition

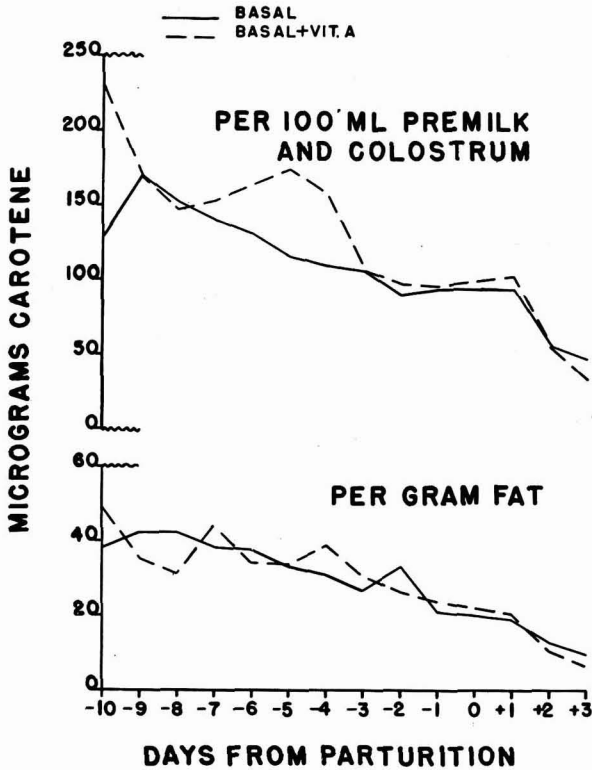


FIG. 5. The effect of prepartum milking on the trends in the carotene content of both pre-milk and colostrum.

there was little change in either the carotene or vitamin A content of the pre-milk, so that from the third day prior through the first day following parturition there were no significant differences between days. Therefore, it is reasonable to assume, that parturition does arrest temporarily the drop in both the carotene and vitamin A contents of the pre-milk and colostrum. The prepartum feeding of

<sup>2</sup> Similar data were obtained on the proximate principles which agreed with those in the literature.

supplementary vitamin A resulted in higher average levels ( $P < 0.05$ ) of vitamin A in the pre-milk and colostrum, but had no noticeable effect on the carotene content.

## DISCUSSION

These data indicate that both management and diet may influence markedly the composition of colostrum. Prepartum milking decreases both the carotene and the vitamin A content of colostrum. However, the prepartum feeding of

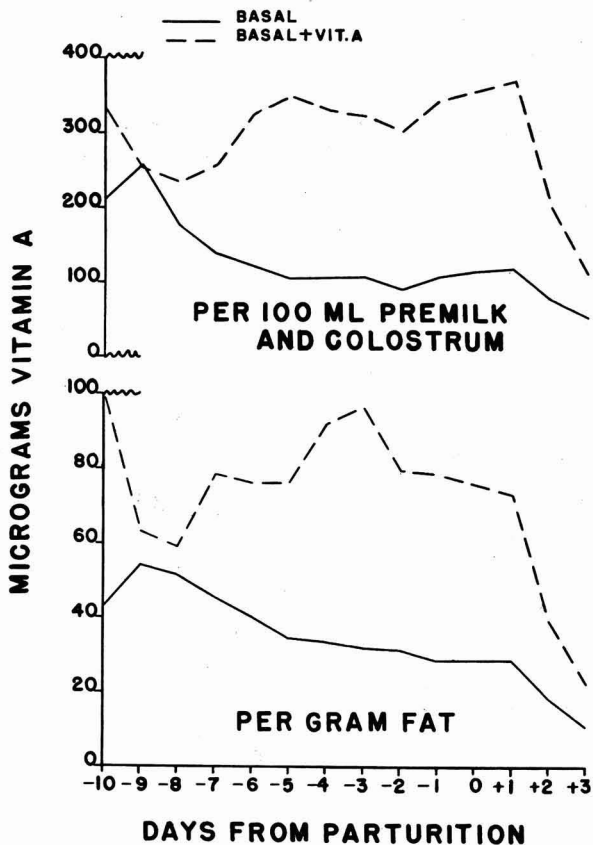


Fig. 6. The effect of prepartum milking on the trends in the vitamin A content of both pre-milk and colostrum.

supplementary vitamin A can maintain higher levels of vitamin A in cows milked prepartum than are found in cows milked only postpartum and fed only on the basal ration. The effect of prepartum feeding of vitamin A supplements on the carotene and vitamin A contents of colostrum in the cows milked only postpartum agrees with the recent data reported by Parrish *et al.* (8) and others (5, 10).

The changes in the proximate constituents of colostrum from cows milked prepartum also are in agreement with previous studies. Prepartum milking for a week or more before parturition has been shown to result in colostrum closely resembling normal milk in proximate composition (7, 11) and to decrease the globulin and albumin components of the protein (7, 11, 12, 13). Similar results have been reported for continuous milking from one lactation to the next (4) and for the initiation of lactation before pregnancy or early in pregnancy (1, 14).

The decrease in carotene and vitamin A with successive prepartum milkings follows the trends reported for the protein, ash, and lactose (7, 11, 12, 13). Although there was a tendency for both carotene and vitamin A to be affected by parturition in the study reported herein, the magnitude of this change and the trends in the carotene levels of pre-milk and colostrum are not in agreement with those reported by Keyes *et al.* (6). When carotene and vitamin A are related to the content of fat, the changes occurring at parturition are even less apparent. It is of interest that Eckles and Palmer (4) also reported an increase in the albumin and globulin at the time of calving in cows milked continuously from the previous lactation, although later workers (7, 11, 12, 13) did not confirm these findings.

#### SUMMARY

The effect of prepartum milking for 10 days prior to the calculated parturition date on the carotene, vitamin A and proximate composition of colostrum has been studied in 44 cows. In addition, the changes occurring in the carotene and vitamin A contents of both pre-milk and colostrum were observed in 14 of these cows milked for 10 or more days prepartum. Secondly, the effect of feeding one million USP units of vitamin A daily for 30 days prior to the calculated parturition date was measured.

Prepartum milking resulted in significant decreases in the carotene, vitamin A, protein and ash contents and in the specific gravity and significant increases in the lactose content of the colostrum from the first six milkings postpartum. Both carotene and vitamin A decreased with successive milkings in the pre-milk and colostrum of cows milked for more than 10 days prepartum. Parturition affected this decrease by temporarily causing a decrease in the negative trend.

The prepartum feeding of supplementary vitamin A increased significantly the vitamin A content of both pre-milk and colostrum and decreased the carotene content of colostrum.

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PARTURIENT PARESIS. III. A STUDY OF VARIOUS BLOOD  
CONSTITUENTS AT PARTURITION IN  
MASTECTOMIZED COWS<sup>1, 2</sup>

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Mastectomized animals have been used to study various phenomena related to lactation and reproduction. Bert (5), Moore and Parker (25), Marshall and Kirkness (24) and Porcher (28) analyzed the blood and urine of mastectomized animals before and after parturition to determine the site of lactose formation. Shattock (33) removed the mammary glands from guinea pigs to ascertain whether or not the mammary gland produced an internal secretion necessary for growth of the fetus. Sellheim (31) postulated that eclampsia was caused by toxins formed in the mammary gland and reported recovery from eclampsia after removal of the breasts of one patient. A review of some of the early European literature on the relation of the udder to reproduction is covered by Addis (1). Eddington (9) used udderless cows to study the role of the udder in dissemination of *Brucella abortus*. Analyses for blood calcium and phosphorus near the time of parturition were made by Wilson and Hart (37) on a mastectomized goat.

Many workers have proven conclusively that at the time of parturient paresis there is a drop in total serum calcium as well as inorganic phosphorus levels in the blood, usually accompanied by an increase in the magnesium level (2, 4, 8, 10, 11, 12, 17, 18, 20, 21, 22, 23, 28, 29, 30, 34, 35). These changes seem to be accentuations of the trends in the blood mineral picture in normal parturitions (2, 8, 16, 17, 27, 37). The decrease in serum calcium and plasma phosphorus may be caused by either an increased demand for serum calcium and phosphorus as the result of the initiation of lactation, or physiological changes characteristic of parturition which may influence the blood mineral picture or a combination of the two. If the sudden demand for calcium and phosphorus at the onset of lactation is solely responsible, then initiation of lactation before parturition should reduce the incidence of parturient paresis. However, studies reported by Smith and Blosser (36) showed that prepartum milking had little or no effect on reducing the incidence of parturient paresis. Also, Niedermeier and Smith (26) observed parturient paresis in a Jersey cow not milked following parturition.

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<sup>1</sup> Part of these data were taken from a thesis presented by R. P. Niedermeier to the graduate faculty of the University of Wisconsin in partial fulfillment of the requirements for the degree of Doctor of Philosophy.

<sup>2</sup> Published with approval of the director of the Wisconsin Agricultural Experiment Station.

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This study was undertaken to ascertain the effect of parturition uncomplicated by the initiation of lactation on some of the blood constituents at calving, with emphasis upon those constituents particularly related to the milk fever syndrome.

## EXPERIMENTAL

Four Jersey cows and one Guernsey cow were mastectomized according to the technique described by Frank (15). Epidural and local anaesthesia were used, and each half of the udder was removed separately. The principal blood vessels were ligated. The cut edges of the skin were sutured together and pressure body bandages were applied to control postoperative bleeding. Physiological saline was given after the operation as prophylactic treatment to prevent shock. Recovery was rapid with no apparent abnormal effects on the animals.

TABLE 1  
*History of cows used in study*

Cow no.	Age (yr.)	No. of parturition	Previous attacks of parturient paresis	Breed	Date of parturition
Experimental					
AS-19	10	8	2	Jersey	4- 9-47
1-J	2	1	0	Jersey	1-13-47
1-J	3	2	0	Jersey	1-28-48
1-J	4	3	0	Jersey	1- 8-49
731	5	3	0	Jersey	1-11-48
695	8	5	1	Jersey	4- 9-48
OY-23	?	?	3	Guernsey	5-20-48
OY-23	?	?	3	Guernsey	4-30-49
Control					
720	7	4	0	Jersey	1- 5-49
732	5	3	0	Jersey	1-17-48
696	8	5	0	Jersey	4-12-48
589	4	2	0	Guernsey	5-24-48
559	7	5	0	Guernsey	4-24-49

Five intact cows were paired with some of the mastectomized cows to serve as controls. The controls were selected to correspond with the mastectomized cows in respect to age, number of parturitions and date of parturition, and were subjected to the same feeding and management procedures. Cow 720 was the control for the third parturition of 1-J; 732 for 731; 696 for 695; 589 for the first parturition of OY-23; and 559 for the second parturition of OY-23. Calving dates and histories of these animals are presented in table 1. Blood samples were taken at approximately the same time daily, usually beginning the fifth day before the expected calving date and continued for 5 days postpartum. On the day of calving, samples were taken at 1 to 3, 5 to 7, and 9 to 11 hours after parturition.

Serum calcium was determined by the Clark and Collip (6) method, plasma phosphorus by the Fiske and Subbarow (14) method, serum magnesium by the method of Simonsen *et al.* (32), and plasma fat by Allen's (3) method.

## RESULTS

The results of analyses of the various blood constituents for mastectomized and control cows are presented in tables 2, 3, 4 and 5. Averages given include only the five mastectomized parturitions for which there were control cows.

The serum calcium levels of the cows are presented in table 2. These results show that the serum calcium level of the mastectomized cows decreased slightly on the day of calving, with a very rapid recovery and an increase in postpartum levels above the prepartum level. This is in contrast to the charac-

TABLE 2

*Comparison of the serum calcium before and after parturition of mastectomized and intact cows*

Cow	Blood serum calcium (mg. %)													
	Days prepartum					Day of parturition			Days postpartum					
	5	4	3	2	1	1-3 hr.	5-7 hr.	9-11 hr.	1	2	3	4	5	
Experimental														
AS-19	10.6	11.2	11.0	10.8	10.8	9.4	10.1	10.6	11.5	11.7	11.3	11.0	10.3	
1-J	10.9	11.2	11.5	11.4	11.2	.....	.....	11.2	10.8	11.0	10.5	11.0	11.4	
1-J	10.2	.....	10.3	10.6	11.2	10.6	10.6	10.6	10.4	10.9	10.8	11.1	10.8	
1-J	11.3	10.3	9.8	11.3	10.8	10.0	9.6	10.7	10.7	10.8	11.2	10.9	10.7	
731	10.4	10.5	10.2	10.2	10.2	9.9	9.9	10.2	11.0	10.7	10.8	10.6	10.1	
695	9.6	9.7	9.5	9.5	9.7	.....	.....	9.4	9.3	10.2	10.4	10.5	10.6	
OY-23	10.4	10.1	10.5	10.3	10.2	9.9	10.3	10.8	10.8	11.6	11.3	11.1	11.3	
OY-23	10.0	10.8	9.6	10.5	10.6	10.9	10.3	10.7	10.9	11.0	11.0	10.8	10.9	
Control														
720	.....	.....	10.2	10.9	10.0	9.2	9.6	9.6	9.3	9.1	9.5	9.8	10.1	
732	11.0	11.4	11.1	10.8	9.8	8.8	8.5	8.3	7.8	9.8	11.3	11.0	10.3	
696	10.3	10.5	10.5	9.4	10.4	6.5	5.8	5.7	6.5	6.2	6.9	6.9	.....	
589	.....	.....	11.1	11.2	10.7	10.5	9.5	10.2	9.3	10.4	10.7	10.5	10.4	
559	11.2	11.6	11.6	11.6	11.3	8.9	10.0	9.3	9.5	9.2	9.9	10.2	9.9	
Average of five experimental parturitions and their controls														
Experi- mental						9.9	10.4	10.3	10.2	9.9	10.3	10.7	10.9	11.0
Control						10.9	10.8	10.4	8.8	8.7	8.6	8.5	8.9	9.7

teristic change shown in the control cows. The serum calcium of the control cows declined from a level of 10.4 mg. per cent 1 day prepartum to a low of 8.5 mg. per cent 1 day postpartum, and the subsequent recovery period was much slower than that of the experimental cows. This perceptible drop in the serum calcium level occurred in each of the control cows, and with cow 696 the level was close to that found in milk fever. In the mastectomized cows an examination of the individual cow data reveals no such consistent trend, and where the drop did occur it was of much less magnitude.

Plasma phosphorus levels of the two groups, as shown in table 3, in general paralleled each other, with a slightly higher level throughout the sampling period for the mastectomized animals. As in the case of calcium, the control

TABLE 3  
*Comparison of the inorganic plasma phosphorus before and after parturition  
of mastectomized and intact cows*

Cow	Blood plasma inorganic phosphorus (mg. %)												
	Days prepartum					Day of parturition			Days postpartum				
	5	4	3	2	1	1-3 hr.	5-7 hr.	9-11 hr.	1	2	3	4	5
Experimental													
1-J	4.6	4.5	5.5	5.0	4.2	2.7	3.8	4.6	4.9	5.2	5.2	4.6	4.3
1-J	5.1	4.8	5.1	5.1	4.2	3.1	3.9	4.6	4.5	6.9	6.4	6.5	6.1
731	4.2	4.8	3.9	4.8	3.7	3.2	4.8	4.4	3.9	4.1	5.1	4.9	
695	6.4	4.7	5.0	5.7	4.8	.....	4.8	3.2	3.6	3.2	3.7	3.9	4.1
OY-23	3.7	3.6	3.6	3.9	3.8	2.8	3.7	3.0	2.4	3.3	3.9	3.9	4.0
OY-23	4.3	7.7	6.7	6.4	4.7	5.3	4.3	4.3	3.9	7.2	6.9	6.8	7.2
Control													
720	.....	.....	3.7	3.6	3.2	2.7	2.9	2.6	2.7	3.4	4.0	4.7	4.8
732	3.2	3.8	3.9	4.1	2.4	2.3	3.2	3.2	3.5	4.1	4.8	3.9	5.6
696	4.3	4.4	5.2	5.3	5.0	1.0	1.3	2.7	3.1	4.6	6.0	4.4	4.0
589	.....	.....	2.8	3.8	2.4	2.4	2.7	2.6	4.2	4.2	3.7	3.9	3.0
559	5.2	6.1	5.6	6.6	4.0	2.8	2.5	3.1	3.9	4.2	4.6	5.3	5.4
Average of five experimental parturitions and their controls													
Experi- mental			4.9	5.2	4.2	2.9	4.3	3.9	3.7	4.9	5.2		
Control			4.2	4.7	3.4	2.2	2.5	2.8	3.5	4.1	4.6		

TABLE 4  
*Comparison of the serum magnesium before and after parturition  
of mastectomized and intact cows*

Cow	Blood serum magnesium (mg. %)												
	Days prepartum					Day of parturition			Days postpartum				
	5	4	3	2	1	1-3 hr.	5-7 hr.	9-11 hr.	1	2	3	4	5
Experimental													
1-J	2.5		2.6	2.3	2.7	2.4	2.6	2.5	2.4	2.7	2.5	2.4	2.6
1-J	2.7	2.9	2.5	3.3	2.7	3.0	2.8	2.8	2.4	2.3	2.6	2.4	2.4
731	2.1	2.4	2.3	2.4	2.4	2.5	2.5	2.5	2.4	2.4	2.3	2.1	2.4
695	3.0	2.8	2.6	2.4	2.4	.....	2.4	2.4	1.9	1.9	2.0	2.2	2.4
OY-23	2.1	2.4	2.4	2.5	2.7	2.5	2.5	2.3	2.4	2.4	2.4	2.4	2.4
OY-23	2.7	2.8	2.6	2.6	2.6	2.6	2.7	2.7	2.5	2.4	2.4	2.6	2.6
Control													
720	.....	.....	2.6	.....	2.8	2.9	3.3	3.1	3.2	2.9	2.7	.....	2.2
732	2.4	2.6	2.6	2.7	2.7	3.3	3.4	3.7	3.4	2.9	2.1	2.3	2.3
696	2.3	2.4	2.5	2.5	2.6	4.2	4.3	4.1	4.2	4.0	2.8	1.9	1.8
589	.....	.....	2.7	2.7	2.7	2.7	2.5	2.4	2.5	2.5	2.4	2.2	2.0
559	2.5	2.5	2.1	2.2	2.5	3.0	3.2	2.8	3.2	2.7	2.2	2.1	2.0
Average of five experimental parturitions and their controls													
Experi- mental			2.5	2.6	2.6	2.6	2.6	2.5	2.3	2.3	2.3		
Control			2.5	2.5	2.7	3.2	3.3	3.2	3.3	3.0	2.4		



group shows the more consistent trend, inasmuch as the experimental group has a definite increase in the 5 to 7 hr. period as compared to the 1 to 3 and 9 to 11 hr. periods. This very possibly would disappear if larger numbers were involved. Table 4 points out a strikingly different serum magnesium level between the experimental and control animals. The serum magnesium level of the mastectomized cows remained quite constant, with a slightly lower level in the postpartum period beginning on the day of calving. In the control cows the average began to increase the two days prepartum, beginning at 2.5 mg. per cent and increasing to 3.3 mg. per cent 1 to 3 hr. postpartum. This was followed

TABLE 5

*Comparison of the plasma fat before and after parturition of mastectomized and intact cows*

Cow	Blood plasma fat (mg. %)												
	Days prepartum					Day of parturition			Days postpartum				
	5	4	3	2	1	1-3 hr.	5-7 hr.	9-11 hr.	1	2	3	4	5
Experimental													
AS-19	170	213	214	225	158	161	158	157	199	205	192	184	177
1-J	166	174	211	192	194	197	187	192	202	205	226	205	210
1-J	216	202	215	211	196	201	179	194	187	175	196	187	191
731	149	154	137	133	145	124	127	129	141	133	132	155	145
695	186	173	162	165	157	.....	161	156	153	152	156	164	161
OY-23	216	216	214	219	207	187	240	221	241	219	225	236	246
OY-23	203	199	202	188	210	199	180	178	177	190	185	175	185
Control													
720	.....	.....	209	186	172	145	158	164	165	162	174	164	164
732	144	164	154	149	144	123	110	120	116	119	109	162	153
696	.....	193	189	165	178	131	128	127	103	109	130	122	136
589	.....	.....	206	198	185	183	172	168	168	154	149	149	174
559	209	206	201	192	180	153	156	155	158	167	149	144	132
Average of five experimental parturitions and their controls													
Experi- mental			186	183	183	178	177	176	180	174	179		
Control			192	178	172	147	145	147	142	142	142		

by a gradual decline to prepartum levels by the third day postpartum. Control cow 589 had no increase in her serum magnesium level.

There was little change in the plasma fat levels of the mastectomized cows as a result of parturition. The control cows showed a rather constant decline in the plasma fat from the third day prepartum to 1 to 3 hr. postpartum, with the level remaining quite constant from 1 to 3 hr. to 3 days postpartum.

#### DISCUSSION

As indicated by the foregoing data and results, the blood mineral levels of calcium and magnesium are markedly different for the two groups. The control cows exhibit the characteristic decrease in serum calcium at parturition reported

by many workers in other than first calf heifers. The mastectomized cows exhibit little change as compared to the cows calving with intact udders. An increase in blood magnesium levels in cows with parturient paresis has been reported by numerous workers (2, 4, 17, 29, 30, 35). They also have shown a tendency in this direction in normal calvings. It was suggested by Hibbs *et al.* (20) that the rise in magnesium may be explained as a compensatory mechanism for the concurrent drop in calcium and phosphorus. Using this line of reasoning, one might assume that the increase in magnesium did not occur in the mastectomized cows because a very small drop in the serum calcium level occurred. A major portion of the difference in the magnitude of the drop in serum calcium between the two groups logically may be attributed to the mobilization of calcium for the secretion of milk in the cows calving with intact udders.

In contrast to the other minerals studied, the plasma phosphorus levels for the two groups were similar in their magnitude of decrease. Palmer *et al.* (27) noted an appreciable increase of inorganic phosphorus 15 min. after exercise, followed by a marked decrease which persisted for at least 2 hr. after exercise. The exercise involved in parturition may contribute to the drop in plasma phosphorus. The decrease of the plasma phosphorus in both groups is of the magnitude of that reported by other workers for normal calvings of cows with intact udders. No significance is attached to the slight differences in prepartum levels of calcium or phosphorus between the experimental and control groups, inasmuch as they fall within the normal range reported by Alleroft (2).

The decrease in the plasma fat levels of the normal cows at parturition is in agreement with the results reported by Allen (3). Compared with the control group, the mastectomized cows showed little change in plasma fat levels.

#### SUMMARY

The serum calcium and magnesium, and the plasma phosphorus and fat levels have been determined for 5 days prepartum, three times on the day of parturition, and 5 days postpartum for eight parturitions of five mastectomized and five parturitions of five intact cows.

Data are presented showing a greater, more consistent decline in the serum calcium and plasma fat of the intact cows than the mastectomized cows. Serum magnesium levels increased in the cows calving with intact udders and showed no appreciable change in the mastectomized cows. Plasma phosphorus levels showed a drop in both groups of cows.

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## CHANGES IN QUALITY OF CREAM MARKETED THROUGH BUYING STATIONS<sup>1, 2</sup>

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In the last few years members of the butter industry have carried out extensive educational programs to encourage the production of better quality cream on the farm. The need for such improvement is genenerally recognized. Also, it usually is appreciated that under the average conditions involved in the marketing of cream through buying stations, changes in quality may continue until the cream is processed at the plant.

Manhart (6) studied the effect of the time element associated with marketing on the quality of cream in Indiana. He found that, under conditions of the study, butter made from cream 4 days or less old when sold by producers generally scored 1.22 points higher than butter from cream over 4 days old. He further found that an extended interval between delivery of cream to the station and processing at the creamery resulted in lower butter quality than when this interval was short. The higher quality cream deteriorated more than the lower quality cream during the period. The atmospheric temperatures involved were not indicated. Martin, Fay and Caulfield (7) showed that, although good cream held at 50° F. remained first grade for an average of 15 days, it became second grade in an average of 2 days when held at 90° F. Morrison, Nelson and Martin (8) found that the quality of cream decreased rapidly during holding in the cream station.

Over a period of years, various reports (2, 3, 4, 5) from the Dairy Commissioner, Kansas State Board of Agriculture, repeatedly indicated that a high percentage of cream in Kansas was of first grade quality when delivered by producers to stations. However, this percentage was much lower just prior to processing at the creamery. The reports indicated the need for getting cream to the churn with minimum deterioration and emphasized the necessity for reduction in the interval involved together with the employment of adequate cooling.

The problem of change in quality of cream between the time of purchase at stations and processing at creameries is recognized by members of the butter industry. Efforts have been made to improve the methods of handling cream during the period involved. Because of the importance of the quality problem and the necessity of directing efforts where they may be most effective, it is essential to know more specifically the extent of deterioration now occurring during the marketing intervals. The following study was undertaken to determine the quality of cream at the time of delivery to the buying station by Kansas pro-

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ducers and the extent of any changes that develop under practical conditions until the cream is processed at the creamery.

#### METHODS

*General procedure.* The study was facilitated through the cooperation of a number of cream station operators and creamery representatives. It was carried out over a period of 1 year so that seasonal influences would be included. Cream buying stations were contacted in several areas to minimize any effect of regional quality. Although efforts were made to obtain representative cream stations, it is possible that those cooperating were more progressive than average. Since mechanical coolers are not common in stations in Kansas, only one station so equipped was included among those involved in the study.

Each station was visited on a day, usually Saturday, when cream receipts were expected to be relatively large so that the cream examined would represent a larger proportion of that marketed during a given period. Through the cooperation of the creameries involved, arrangements were made to re-examine the same cream at the creamery just prior to processing under prevailing plant schedules. In the summer, this usually was the day following purchase at the station. During winter, it was 1 to 3 days later. It is possible, in some instances, that the movement of cream from stations to creameries was more prompt on the days of sampling than at other times.

In all instances records were made of the general weather conditions on the days of sampling at the stations and at the creameries. Data were recorded on the weight, temperature and frequency of delivery of cream delivered by producers. At the creamery information relative to cream temperature, methods of handling, and the time interval between purchase from producers and processing in the plant was recorded.

*Sampling procedure.* A 4-oz. sample was taken directly from the well-stirred cream of each lot at the time of delivery by producers and this sample immediately was placed in ice water. The ladle used for sampling was rinsed in warm water and then in a hypochlorite solution (200-300 p.p.m.) after sampling each delivery to minimize contamination from one lot of cream to the next. After sampling, the cream delivered by the producers was dumped into 10-gallon cans in the usual manner followed in the buying stations. As each 10-gallon can was filled, a record was made of the individual deliveries contained. A sample then was taken from the full can in the same manner as from the separate lots of cream delivered by producers. The cans were tagged, using metal poultry seals, so that they could be identified subsequently at the creamery. All cream samples obtained were held iced and examined in the laboratory as promptly as possible.

After arrival at the creamery, and in accordance with the regular plant schedule, the cream from the tagged cans was re-examined and sampled just prior to processing. At this time the opinion of the butter-maker relative to scores and grades of the cream was noted. The samples were iced and returned to the laboratory for analyses. All sampling at stations and creameries was done by the same person so that methods and handling practices were consistent.

*Quality determinations.* Quality was determined on the basis of organoleptic tests supported by titratable acidity and formol titrations. Examinations were made on the samples representing individual deliveries and also on samples from the 10-gallon cans of cream as filled in the station, to indicate the quality of cream when first received. Similar tests were made on the samples obtained from the same 10-gallon cans of cream at the creamery, thereby showing the quality at the time of processing. Cream samples were scored for flavor according to the method commonly used in the butter industry where the numerical score is based on the estimated quality of the butter that should be obtained. Such flavor scores were used in preference to grades so that smaller differences in quality could be designated. Samples were scored in the laboratory by two experienced judges working independently. In the case of all samples obtained at creameries, the scores given by the butter-makers also were available for reference. Acidity determinations were made by titrating 9 g. of cream plus 9 ml. of distilled water with 0.1 *N* NaOH, using phenolphthalein as the indicator. Formol titrations were made by the method used by Martin, Fay and Caulfield (7) except that 2 ml. of formalin were used instead of 10 ml.

During the period of a year, 11 field trials were conducted involving 163 lots of cream delivered by producers to 9 stations. The number of deliveries examined at each station contact ranged from 7 to 21 and averaged slightly less than 15. The stations were located in eight towns in seven Kansas counties and shipped to seven different creameries in six counties. The distance that cream was shipped or hauled varied from 25 to 100 miles.

## RESULTS

*Cream as delivered to buying stations.* The quality of farm-separated cream delivered to buying stations by producers varied over a wide range (table 1).

TABLE 1  
*Cream as delivered to buying stations by producers*

Field trial	Month	Approx. outdoor temp.*		No. of deliveries	Weight of delivery		Flavor score	
		Range	Mean		Range	Av.	Range	Av.
		(° F.)	(° F.)		(lb.)	(lb.)		
1	June	50-64	57	21	10-82	35.5	89-92	90.8
2	June	64-80	72	7	13-40	30.3	88-91	90.2
3	July	68-84	76	15	5-40	20.6	89-91.5	90.2
4	Aug.	88-104	96	9	7-35	21.3	89-93	91.2
5	Sept.	72-102	87	20	11-47	23.6	88-91	90.2
6	Sept.	60-84	72	19	5-35	24.5	89-93	91.4
7	Nov.	32-54	43	20	4-42	17.6	90-92	91.2
8	Feb.	30-40	35	15	9-52	27.2	90.5-93	91.6
9	Apr.	60-84	72	18	8-79	35.3	90-92	90.9
10	Apr.	64-80	72	7	30-40	34.2	90-91.5	90.9
11	June	60-80	70	12	7-63	27.4	88-92	91.0
Summary		30-104		163	4-82	27.0	88-93	90.9

\* On day of sampling at station.

Study of the data involving the 163 individual deliveries showed that 82 per cent of the deliveries scored from 90 to 92 inclusive, with 13 per cent scoring below 90 and 5 per cent scoring above 92. Although varying amounts of deterioration had occurred in the cream on the farm, 58 per cent of the deliveries scored 91 or better.

In general, the cream was of lower quality during hot weather than during cool and moderate weather. When the mean outdoor temperature<sup>3</sup> was above 70° F. on the days of sampling, the average score of the cream was 90.7 with 47

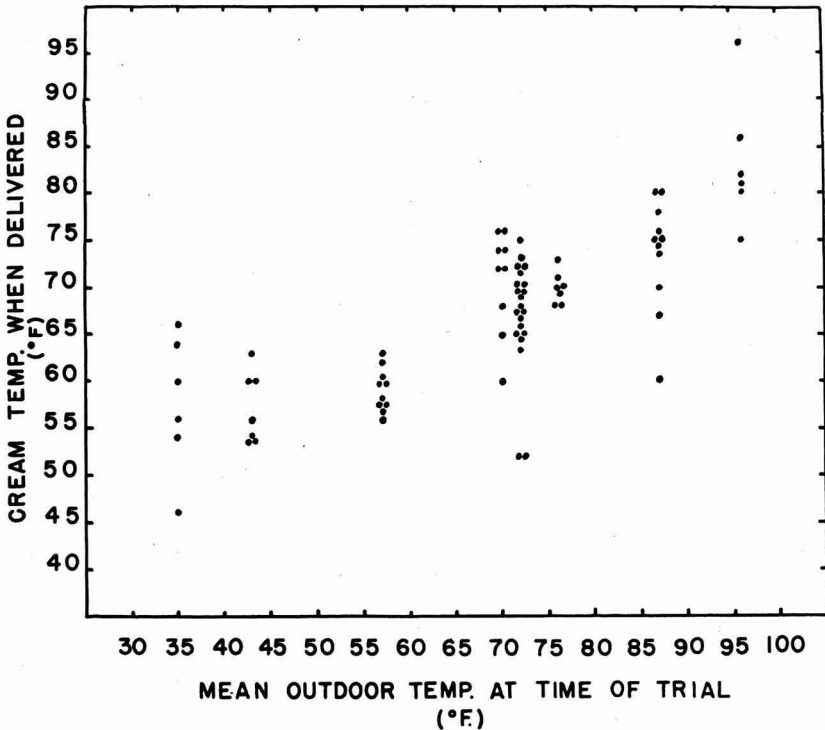


FIG. 1. Relationship of cream temp., when delivered, to mean outdoor temp. at time of trial. (77 deliveries.)

per cent of the deliveries scoring 91 or better and 18 per cent scoring below 90. When the mean outdoor temperature was 70° F. and below, the average cream score was 91.1 with 71 per cent of the deliveries scoring 91 or better and only 7 per cent scoring below 90.

Although temperature readings at the time of delivery were not obtained on all the cream, 77 of the deliveries ranged from 46° F. in cool weather to 96° F. in hot weather, with an average temperature of 67.4° F. The temperature of

<sup>3</sup> Average of approximate minimum and maximum temperatures.



cream when delivered showed a general relationship with the mean outdoor temperature at the time (Fig. 1). An attempt was made to relate the temperature of the cream at the time of delivery to quality. However, the relationship was not particularly marked and was only significant during warmer weather. In trials when the mean daily outdoor temperature was above 70° F. the correlation coefficient was  $-0.337$  for 45 deliveries (significant at 5 per cent level). Also, when the mean daily outdoor temperature was 70° F. and below, the relationship between cream temperature at the time of delivery and quality was non-significant, as indicated by a correlation coefficient of  $+0.068$  for 32 deliveries.

There was no definite relationship between weight of delivery and quality at delivery. When the mean outdoor temperature was above 70° F. the correla-

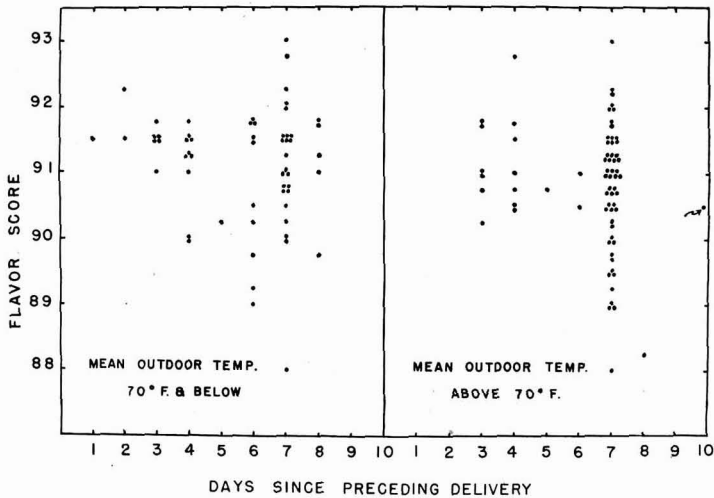


Fig. 2. Distribution of cream deliveries according to flavor score and frequency of delivery.

tion coefficient between weight and quality of 68 deliveries was  $-0.149$ . When the mean outdoor temperature was 70° F. and below the correlation coefficient for 93 deliveries was  $+0.168$ .

The length of time since the previous delivery by the same producer (frequency of delivery) was obtained on 130 deliveries. This interval ranged from 1 to 10 days, with an average of 6 days. In 60 per cent of the cases the interval between deliveries was 7 days or more, indicating the tendency to make once-a-week delivery. An effort was made to determine the relationship between the frequency of delivery of the cream and its quality when sold. Since it seemed possible that the relationship might be closer during warmer weather than in cooler weather, the data on the deliveries were divided, as in previous correlations, into the group representing mean outdoor temperatures above 70° F. and the one representing temperatures of 70° F. and below. Figure 2 indicates that

there was no marked relationship between the frequency of delivery of the cream and its flavor score when delivered. For further verification, correlations were determined on the two groups. During the warmer weather, as might be expected, there was some tendency toward higher quality with more frequent delivery. In trials in which the daily temperature averaged above 70° F. there was a slight relationship between age and score for 72 deliveries, as indicated by a correlation coefficient of  $-0.276$ , which is significant statistically. At mean outdoor temperatures of 70° F. and below, the coefficient for 58 deliveries was  $-0.165$ , which is not significant. These values may have been influenced by the uneven distribution resulting from the larger number of deliveries at the 7-day period.

*Cream as processed at creameries.* During the interval between delivery of the cream at the station and processing at the creamery, there was definite deterioration in quality (table 2). The quality changes involved reductions in average flavor scores for each trial ranging from 0.3 to 1.2 points, with an over-all average decrease of 0.7 points. Changes in titratable acidities generally conformed to changes in flavor scores. Although changes in formol titrations occasionally were inconsistent, the average change was in accordance with other quality changes. The 61 individual 10-gallon cans of cream involved had a drop in score ranging from 0 to 2.0 points. Only three cans of cream had no change during the interval. Twenty-seven decreased 0.25 to 0.5 point in score, while 27 others lost 0.75 to 1.0 point. Four cans of cream dropped 1.25 to 2.0 points in score. The average loss in flavor score for the 61 cans was 0.7 points. The expected repeatability of these results is indicated by the fact that the true average loss in score probably lies between 0.5 and 0.8 points, as determined by 99 per cent fiducial limits.<sup>4</sup>

The amount of deterioration that developed in the cream during the interval between purchase at the stations and processing at creameries was correlated somewhat with the temperature of the cream just prior to processing. This was indicated by a correlation coefficient of  $+0.295$  for 51 cans of cream on which temperatures were available (significant at 5 per cent level). However, this relationship was not particularly marked and probably was influenced by the different holding periods involved, possible temperature variations during the holding period and differences in the quality of the cream when purchased.

Except for trials 4 and 11 where some type of cooling was used, the cream temperature at the creamery varied generally with the outdoor temperature. The extent of deterioration tended to be related to the mean outdoor temperature. This was shown by a correlation coefficient of  $+0.363$  for the 61 cans of cream involved (significant at 1 per cent level). Less deterioration usually occurred during the cooler months, even though the holding periods involved sometimes were longer. The greatest average loss in flavor score (1.2 points) occurred during the hottest weather (trial 4). Observations made during the study indicated that, in warm weather and without effective cooling, cream that was of high

<sup>4</sup> Although it is doubtful that the losses in score follow closely a normal frequency distribution, it is believed that means of samples of 61 observations will do so, and hence the fiducial limits technique used here is satisfactory.

TABLE 2  
 Cream as collected at stations and as processed at creameries  
 (Cream accumulated in 10-gallon cans)

Field trial	Month	Approx. <sup>a</sup> outdoor temp. range	No. of 10-gal. cans	Method of cooling		Av. cream temp. at creamery	Approx. <sup>b</sup> interval involved	Flavor score		Titratable acidity		Formol titration	
				Station	Creamery			At stations	At creamery <sup>d</sup>	At stations	At creamery <sup>d</sup>	At stations	At creamery <sup>d</sup>
1	June	50-70	9	none	none	56	(hr.)	90.9	90.2	0.59	0.68	3.0	2.5
2	June	64-80	4	none	none	72	20	89.3	89.5	0.64	0.84	2.9	3.3
3	July	68-90	4	none	none	77	20	89.8	89.0	0.92	1.10	3.0	3.7
3	Aug.	88-104	3	none	spray	75	20	91.4	90.2	0.62	0.83	2.4	2.6
5	Sept.	72-102	6	not used	none	84	20	89.8	88.9	0.82	1.15	3.4	4.0
6	Sept.	60-84	6	none	none	72	20	91.5	90.7	0.68	0.81	3.0	2.6
7	Nov.	32-54	6	none	not used	58	40	91.6	91.0	0.53	0.60	2.3	2.5
8	Feb.	28-40	6	none	not used	40	40	91.5	91.0	0.45	0.62	2.0	2.2
9	Apr.	60-84	9	not used	not used	74	20	91.1	90.4	0.52	0.63	2.8	3.1
10	Apr.	64-80	4	not used	not used	45	24	91.2	90.6	0.57	0.66	2.5	2.7
11	June	60-80	4	“walk-in”	“walk-in”	45	68	91.2	90.9	0.53	0.64	2.4	2.9
Summary		28-104	61			68.1	29.8	90.9	90.2	0.62	0.78	2.7	2.9

<sup>a</sup> During period from purchase at station to processing at creamery.

<sup>b</sup> Interval between purchase at station and processing at creamery.

<sup>c</sup> At time of purchase.

<sup>d</sup> At start of processing.

quality at the time of delivery deteriorated proportionately more during the marketing interval than did the lower quality cream.

A number of stations and most creameries were equipped with some facilities for spray-type cooling. However, these generally were not in use on the days that cream was sampled and examined, even when weather conditions would have justified such use. In trial 11, where "walk-in" type refrigeration was provided at both the station and the creamery, the smallest average amount of deterioration (0.3 points) occurred, even though the interval from purchase to processing was 68 hours and the mean outdoor temperature was 70° F.

#### DISCUSSION

In general the quality of cream delivered to buying stations by producers under Kansas conditions was somewhat higher than anticipated. On the other hand it was evident that a number of producers were marketing cream of inferior quality. The lack of any striking relationship between quality and the size or frequency of delivery is difficult to explain since the temperature of the cream at the time of delivery to the station seldom indicated thorough cooling practices on the farm. Nevertheless, the relationship between the temperature of cream when delivered and its quality was not particularly marked. Cream temperature at the time of delivery, however, is not necessarily indicative of cooling practices followed throughout the entire accumulation period on the farm. It should be noted that the results were obtained under actual commercial conditions and where cream holding and handling practices on farms were neither controlled nor known.

In most trials, cream was moved from the stations to the creameries and processed with a minimum of delay. In some cases the fact that the study was being made may have prompted more rapid movement to and earlier processing at the creamery. It also is possible that standards of operation in the stations contacted were above average, since such frequently is a characteristic where buyers are willing to cooperate. Accordingly, it is considered that the results on the amount of deterioration during the interval between purchase from the producer and processing at the creamery give a conservative measure of the quality changes under average commercial conditions. In general, the change in quality that occurred during the marketing interval would be expected to result in butter of from 0.5 to 1.0 points lower in score than would be warranted by the quality of the cream delivered by producers.

The observation that deterioration was relatively greater in the higher quality cream, in the absence of special precautions, is in accordance with the results of a previous study (1) and generally agrees with the findings of Manhart (6). Such a situation deserves special attention in planning for improvement in cream quality. It emphasizes the fact that any improvement in the quality of cream marketed by producers must be accompanied by corresponding improvement in subsequent handling methods if maximum benefits are to be realized.

The general failure to provide adequate cooling for cream subsequent to purchase from producers undoubtedly is a factor in the quality problem. The fact

that least deterioration occurred where cooling practices were applied most conscientiously and in the face of the longest holding period (trial 11) would suggest that adequate cooling is an important factor in the cream station method of marketing. Although air temperatures in the "walk-in" coolers were not obtained and air cooling usually has not been advocated as satisfactory for cream, the results indicated that even this type of cooling was beneficial in the case involved.

In quality improvement programs, attention must be given to the phase of marketing subsequent to delivery of cream by producers as well as to production on the farm. It would appear that more rapid initial progress would be obtained from efforts so directed than from the more extensive efforts necessary to obtain results with widely scattered producers.

#### SUMMARY AND CONCLUSIONS

A study was made of the changes in quality of farm-separated cream from the time of delivery to buying stations until just prior to processing at creameries. The cream involved 163 deliveries to nine stations through different seasons of the year and was generally representative of cream so marketed in Kansas. From the stations the cream was shipped from 25 to 100 miles to seven different creameries.

Although some of the cream was of relatively high quality at the time of delivery by producers, the average quality and the wide limits of variation showed that deterioration had occurred in cream on the farm. There was no close relationship between cream quality and weight of delivery. The correlations between quality and frequency of delivery and between quality and cream temperature at the time of delivery were low even in warmer weather and not significant in cooler weather.

Definite deterioration occurred in the cream between the time of purchase from the producer and processing at the creamery. Decreases in flavor scores of individual 10-gallon cans of cream ranged from 0 to 2.0 points. In the average scores of cream in each trial, the losses ranged from 0.3 to 1.2 points, with an over-all average loss of 0.7 points. Deterioration generally was greater in warmer weather than in cooler weather and was relatively more extensive in the higher quality cream.

With a few exceptions, cooling procedures were not generally in use in either stations or creameries on the days that cream was sampled and examined, even in warm weather. The limited amount of deterioration that occurred in the case where mechanical cooling was used at both station and creamery suggested the importance of effective cooling in the marketing of cream through stations.

In cream quality programs, besides emphasizing the production phase, consideration must be given to controlling deterioration subsequent to the delivery of cream to stations.

#### ACKNOWLEDGMENT

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## THE KEEPING QUALITY OF PASTEURIZED MILK IN HOME REFRIGERATORS<sup>1</sup>

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It generally is agreed that the practice of every other day delivery of milk that was started during World War II reduced the cost of delivery so much that most distributors prefer to retain the economy of this practice.

With delivery either every other day or 3 days a week the milk must retain its quality up to 4 days after pasteurization. To justify such delivery the consumer must be assured that the product delivered will retain its high quality for at least these 4 days. For this reason, a study was undertaken to determine if good pasteurized milk would retain its high quality when delivered every other day or 3 days a week and kept in home refrigerators under ordinary home conditions.

Several investigations have shown that good quality milk, properly processed, can be kept for a considerable length of time in household refrigerators under laboratory conditions. Very few of these, however, have had the milk subjected to conditions in the ordinary home refrigerators.

Dahlberg (3), in a laboratory study that was somewhat similar to home conditions, made in the New York metropolitan area in 1944 and 1945, showed that the keeping quality of pasteurized milk was good enough at all seasons of the year to permit every other day delivery without impairment of milk quality. He concluded, however, that to insure good keeping quality, milk should not be stored above 50° F.

Burgwald and Josephson (2), found "that milk of good quality can be expected to retain excellent bacteriological and flavor qualities for at least 4 days during the summer months and 6 to 7 days during winter months if refrigerator temperatures are maintained near 40° F."

### METHODS

Sixteen families with electric or gas refrigerators were used as cooperators. They were furnished with quart bottles of ordinary pasteurized milk of the same quality as that sold in the retail store at the University creamery. The milk was cooled immediately after milking and the evening milk was kept in the cooler at the dairy farm and delivered to the University creamery the following morning with the morning's milk. It then was pasteurized (144° F. for 30 min.) and bottled and held in the cooler until the next morning before delivering, as this is the normal procedure in most milk plants.

The quart bottles of milk either were delivered to the homes in the same manner as used by milk plants, or the cooperators secured the milk directly from

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TABLE 1

*Summary of the flavor scores of 207 samples of milk left in 16 home refrigerators from 3 to 7 days under summer conditions*

	Elapsed time				
	3 d.	4 d.	5 d.	6 d.	7 d.
No increase <sup>a</sup>	36	98	43	18	12
Av. flavor score					
Test samples	38.0	38.0	35.5	35.3	34.1
Control samples	39.2	39.0	38.2	38.8	37.5

the creamery. Some of the commuter cooperators lived as far as 20 miles distant from the creamery, in which case the milk received no refrigeration enroute to the homes. The cooperators were asked to use about three-fourths of the milk and to treat this bottle of milk in the same manner as their regularly delivered milk, such as bringing it out at mealtime, shifting it around in the refrigerator, etc. The remainder, or approximately one-fourth (usually less) of the original milk was returned to the laboratory and scored for flavor by a committee of three or more members of the dairy staff. This committee also scored the fresh milk for flavor the day it was delivered.

A bacterial count of the milk was made the day it was delivered and again when the samples were brought from the cooperators at the end of each test period. The plate colony count method was used, as outlined by the American Public Health Association (1). An acidity test, titrating with N/10 sodium hydroxide, with phenolphthalein as an indicator, was made on the milk the day it was delivered and, likewise, when it was brought back to the laboratory from the cooperators. A thermometer was placed in each of the refrigerators and occasional readings made to see if the temperature was within the normal range.

In all, 207 quarts of milk were distributed during the months of May and June, 1946, and June, July and August, 1947. The time of the study, therefore, represented summer weather conditions. The length of time the milk was left with the cooperators ranged from 3 to 7 days. The following flavor scorecard was used to score the returned samples:

TABLE 2

*The percent of total samples that showed varying degrees of increase in acidity (calculated as lactic acid) of milk in home refrigerators from 3-7 days after delivery as compared with acidity on delivery date*

	% of samples showing indicated increase after an elapsed time of:									
	3 d.		4 d.		5 d.		6 d.		7 d.	
	con <sup>b</sup>	con	con	con	con	con	con	con	con	con
No increase <sup>a</sup>	83.3	100	74.0	80	33.3	25	30.0	33	8.3	
Slight increase	13.9		23.0	20	31.2	75	25.0	66	33.3	100
Moderate increase	2.8		2.0		13.3		10.0		25.1	
Great increase	0.0		1.0		22.2		35.0		33.3	

<sup>a</sup> Key to acidity increases: No increase—0.0 to 0.005% lactic acid; slight increase—0.005 to 0.015% lactic acid; moderate increase—0.015 to 0.025% lactic acid; great increase—0.025 and up percent lactic acid.

<sup>b</sup> Con. = control.



- 40 —no criticisms  
 38-40—slightly to moderately off-flavored (good)  
 35-38—distinct off-flavor, distinct absorbed flavor, definitely unpalatable, but still usable (fair)  
 25-35—high acid, bitter, stale, old. Very pronounced off- or absorbed flavor, generally not usable as a beverage (poor)

A quart bottle of milk was placed in the laboratory refrigerator to serve as a control at the time of delivery of the milk to the cooperators. The refrigerator temperature was maintained at 40° F. and the milk bottles were not uncapped until time to be scored for flavor. The results of the flavor score are given in table 1. The figures indicate that good quality milk will retain a good flavor 3 to 4 days after delivery, but after the fourth day there is a decided drop in flavor.

TABLE 3

*Number of samples and percent of total samples that showed varying degrees of increase in bacteria count (by the plate count method) of milk stored from 3 to 7 days in home refrigerators over the bacteria count of the same milk on delivery date*

	Elapsed time									
	3 d.		4 d.		5 d.		6 d.		7 d.	
	No.	%	No.	%	No.	%	No.	%	No.	%
	<i>Test samples</i>									
No increase <sup>a</sup>	15	42.8	16	16.8	5	11.4	0	0.0	0	0
Slight increase	8	22.9	26	27.4	12	27.3	2	9.5	0	0
Moderate increase	4	11.4	15	15.8	10	22.7	4	19.1	0	0
Great increase	8	22.9	38	40.0	17	38.6	15	71.4	12	100
Total test samples	35		95		44		21		12	
	<i>Control samples</i>									
No increase	3	100	3	33	1	25	1	33		
Slight increase	0	0	3	33	2	50	1	33	1	100
Moderate increase	0	0	1	11	0	0	1	33		
Great increase	0	0	2	22	1	25				
Total control samples	3		9		4		3		1	

<sup>a</sup> Key to increases—compared with count the day milk was given to cooperators: No increase—no counts higher than original milk; slight increases—1 to 5 times higher than original milk; moderate increases—5 to 15 times higher than original milk; great increase—15 times or higher than original milk

Of the 3 and 4 day old milk, 97 per cent had none or a slight increase in acidity, while with 5 and 6 day old milk only 64.4 and 55 per cent, respectively, had none or a slight increase. The results from the acidity study are given in table 2.

The number of samples and the percentage increase in bacteria counts in various amounts is given in table 3. The arithmetic average of the initial plate counts was 6,500. The plate counts of returned samples from cooperators showed such a wide variation due to different methods of handling the milk that tabulation would have but little value, but the average percentage increase by days is given. There was a decided increase in bacteria count of 5 and 6 day old milk over the 3 and 4 day old milk.

## DISCUSSION

Considerable difficulty was experienced by the committee in determining the flavor score of returned samples in several instances. This was due mostly to absorbed refrigerator flavors. In some cases the resultant flavor was not too objectionable to some of the committee, while with others it was more serious. This partly was solved by setting up a flavor scorecard as previously mentioned.

As might be expected, there was a wide variation in the way the milk was handled by the cooperators. Certain cooperators were careless in promptly refrigerating the milk and seeing that the cap was put back on the bottle after part of the milk was used. Uncapped milk and caps improperly replaced were responsible for most of the absorbed flavors of the returned samples. In a few cases the committee could tell what product was stored in the refrigerator. In most cases, however, their remarks were "off flavor", "absorbed flavor", or "fruity flavor".

The length of time the milk was without refrigeration when delivered to the cooperators was from 1 to 3 hr. and a period of time somewhat shorter was used in returning the unused portion for laboratory examination. The keeping quality of the milk that was delivered 20 miles from the creamery compared favorably with the milk delivered a few hundred yards. This probably was due to efficient refrigeration and care by the cooperators.

The average temperature of the refrigerators varied from 37 to 52° F., with the higher temperature refrigerators permitting the greatest increase in plate count on the returned samples. Some of the cooperators had consistently higher plate counts and lower flavor scores on returned samples which were not justified by refrigerator temperatures. Some carelessness of the cooperators was found in replacing milk caps on bottles of milk partially used, resulting in lower flavor scores due to absorbed flavors. "Good housekeeping" in the refrigerator is important in keeping the milk free from absorbed flavors.

The control samples kept in the laboratory refrigerator (40° F.) scored consistently higher in flavor and increased less in acidity and bacteria count than did the milk returned from the cooperators as would be expected. Part of the control samples maintained their original flavor score as scored by the committee, but a lower flavor score in some cases was due to a lack of that fine clean flavor of the fresh milk. The committee did not try to differentiate between absorbed and developed flavors but many of the returned samples were criticized as "fruity".

The highest score given any sample of milk was 40 (no criticism). Of the 20 samples of fresh milk scored by the committee, 17 scored 40, 1 scored 39.5 and 2 scored 39 on flavor.

## CONCLUSIONS

Delivery either every other day or three times a week is sufficient for pasteurized milk of good quality, provided the distributor and consumer use reasonable care in handling the product.

Consumer education is needed to aid the family in getting a better appreciation of how to care for the milk after it is delivered.

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## THE EFFECT OF PENICILLIN UPON THE FERTILITY OF SEMEN FROM RELATIVELY INFERTILE BULLS<sup>1</sup>

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In attempts to control the bacteria which are present in bull semen, it was found that penicillin (2) retarded bacterial growth at levels which did not exert an injurious effect upon the livability of the spermatozoa. The first experiment to determine the effect of penicillin upon fertility (1) showed that the addition of either 500 or 1,000 units of penicillin per ml. of diluted semen did not affect significantly the fertility of semen from bulls of relatively high breeding efficiency. Since it has been suggested that semen from bulls of lowered fertility might contain types of bacteria associated with breeding difficulties (3, 4), the present study was conducted to test the effect of penicillin upon the fertility of semen from relatively infertile bulls used in routine artificial breeding.

### EXPERIMENTAL

In cooperation with the Western Pennsylvania Artificial Breeding Cooperative, Clarion, Pa., four Guernsey bulls and one Holstein bull of relatively low fertility were selected. Four concentrations of penicillin, with appropriate controls, were compared using a Latin square experimental design. Levels of 250, 500, 750 and 1,000 Oxford units of penicillin per ml. of yolk-citrate diluter were chosen, as a previous study (2) had shown that these amounts were not toxic to spermatozoa during the time which semen routinely is used in artificial breeding. The 5 × 5 Latin square experiment was repeated three times. The first experiment began December 11, 1946, and the last replicate was completed June 27, 1947. Semen samples were collected from each bull once approximately every 10 days and this interval of time was considered the collection period. During each collection period all treatments were used but the semen from a bull received only one of the five possible treatments.

The crystalline sodium salt of penicillin was dissolved in sterile 3.6 per cent sodium citrate dihydrate buffer. When the design of the experiment involved the addition of penicillin, the desired amount of penicillin solution and citrate buffer were mixed with egg yolk so as to ensure the preparation of a diluter which consisted of a 1:1 ratio of yolk to buffer. However, since the completion of the experiment it has been found that this particular precaution was unnecessary.

All semen was diluted at a fairly constant, though relatively low, rate as indicated by the fact that 70 of the 100 semen samples used in the study were diluted at the rate of 1:10. The average dilution rate was 1:11, with a range of from 1:10 to 1:16. None of the diluted semen was used for insemination on the day

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TABLE 1  
*Fertility of bulls during 6-mo. period prior to experiment*

Bull	No. 1st and 2nd services	% non-returns after		Decrease in % non-returns (correction factor)
		30 to 60 d.	90 to 120 d.	
1 G	315	56.2	48.3	- 7.9
2 G	470	61.1	50.2	- 10.9
3 G	194	50.5	28.9	- 21.6
4 G	595	49.1	30.8	- 18.3
5 H	489	50.9	30.3	- 20.6

of collection so that the penicillin had ample time in which to exert its effect upon bacteria present in the samples.

The fertility of the five bulls during the 6-mo. period immediately preceding the experiment is shown in table 1. While the per cent 90- to 120-day non-returns for each bull is at or below 50 per cent, three bulls exhibited notably large correction factors when comparing 30- to 60-day with 90- to 120-day non-returns. Each of the bulls was producing semen which was average or above in both initial motility and concentration at the time of selection. During the experiment the average motility was 66 per cent. Only two semen samples (bull 1 G) exhibited motility as low as 50 per cent, and the remaining 98 samples showed either 60 or 70 per cent actively motile spermatozoa at the time of collection.

*Average response in fertility to different levels of penicillin.* Table 2 shows the average fertility data for the four levels of penicillin. The per cent non-returns for each individual treatment represent a mean of 20 ejaculates. Analysis of variance of the per cent 6-mo. non-returns for 3,576 first and second services demonstrated that the 500 and 1,000 unit levels of penicillin brought about highly significant ( $P = < 0.01$ ) increases in fertility when compared with the untreated controls. While the 250 and 750 unit levels each increased the apparent conception rate by an average of 8.7 percentage units, the improvement was not statistically significant. The differences, however, did approach significance at the 5 per cent level of probability. The differences in breeding efficiency among the five bulls were highly significant although the interaction of treatments and bulls was not significant even at the 5 per cent point. The latter suggests that the semen of the various bulls reacted in a similar manner when treated with penicillin.

TABLE 2  
*Effect of penicillin upon the fertility of semen from five relatively infertile bulls*

Units of penicillin/ml. of diluter	No. 1st and 2nd services	% non-returns after 6 mo.	Improvement over controls
0	671	48.0	.....
250	749	56.7	+ 8.7
500	677	61.4	+ 13.4
750	757	56.7	+ 8.7
1000	722	63.3	+ 15.3
Combined levels of penicillin	2905	59.4	+ 11.4

Greatest over-all improvement in fertility was obtained with 1,000 units of penicillin per ml. of diluter. As shown in table 2, the difference in favor of this level of penicillin was 15.3 percentage units, i.e., 15.3 per cent more cows apparently conceived than when untreated yolk-citrate diluted semen was used for insemination.

To compare the over-all results of adding penicillin at either 250, 500, 750 or 1,000 units per ml. of diluter with the results obtained where no penicillin was added, the data for the four levels of antibiotic were combined. Of the 2,905 cows inseminated with penicillin-treated semen, there was an average improvement in apparent conception rate of 11.4 percentage units as compared to the 671 cows inseminated with diluted semen containing no penicillin.

*Variations in response of the individual bulls.* As might be anticipated, an examination of the data showed wide variation in the response of the individual bulls when the semen was treated with penicillin. Since the addition of 1,000 units of penicillin per ml. of diluter resulted in the largest improvement in fertility, this level was compared to the untreated controls to show the variation by

TABLE 3  
*The response in fertility of the semen by individual bulls*

Bull	Units of penicillin/ml. of diluter	No. 1st and 2nd services	% non-returns after 6 mo.	Improvement over controls
1 G	0	105	39.0	.....
	1000	86	39.5	+ 0.5
2 G	0	120	49.2	.....
	1000	102	63.7	+ 14.5
3 G	0	101	33.7	.....
	1000	98	65.3	+ 31.6
4 G	0	166	63.3	.....
	1000	224	67.4	+ 4.1
5 H	0	179	46.4	.....
	1000	212	67.5	+ 21.1

bulls. These data are presented in table 3. Treated semen from three of the five bulls showed large increases of 14.5, 21.1 and 31.6 percentage units over the controls. The other two bulls showed only small increases of 0.5 and 4.1 percentage units. There appeared to be little uniformity in the magnitude of the response even among the three bulls which showed greatest improvement. This may be attributed in part to the relatively small number of inseminations in some instances as the inseminators preferred to use semen from bulls of relatively high fertility which was available at the same time.

It will be noted in table 3 that the untreated diluted semen from all of the bulls but one (4G) was below 50 per cent 6-mo. non-returns. However, the control semen for this bull averaged 63.3 per cent or more than double his average of 30.8 per cent 3-mo. non-returns for the period prior to the experiment (see table 1). Based on the control data, therefore, this bull should not be considered a relatively infertile bull. The reason for this marked improvement in fertility is not known. Thus, in reality, only the semen from one of the four bulls (1 G) failed to respond to treatment with penicillin.

## DISCUSSION

The results of this experiment indicate that the addition of penicillin to diluted semen offers a means of improving the breeding efficiency of certain bulls of lowered fertility. That this treatment definitely should not be considered as a cure-all for breeding difficulties with bulls is shown by the failure of one bull to respond, along with the variability in the degree of response of the three bulls showing large increases in fertility.

The 13-yr.-old bull, 1 G, which showed no significant improvement in fertility, illustrates a case in which penicillin treatment of the semen was not beneficial. Toward the end of the experimental period and up to the time of slaughter 7 mo. after the experiment, the fertility of this bull showed a very definite decline. Histological examination of the testes revealed marked degeneration of the seminiferous tubules.

At the time this study was initiated laboratory facilities were not available for bacterial analysis of the treated and untreated semen. While it is possible that the large increases in fertility exhibited by three of the five bulls were due to control of certain harmful types of bacteria, the actual reason for the beneficial effects is not yet known. Further fertility studies with additional relatively infertile bulls are now being completed using penicillin and streptomycin alone and in combination. In addition, bacteriological investigations are in progress to determine whether the beneficial effects of penicillin reported here may be attributed to bacterial control. For the present, the semen from each bull of low fertility will have to be tested by the trial and error method to determine whether the addition of penicillin is of value in improving fertility.

## SUMMARY

Penicillin was added to the semen of five relatively infertile bulls at the rate of 250, 500, 750 and 1,000 units per ml. of diluter. Based on 3,576 inseminations, levels of penicillin of 500 and 1,000 units brought about highly significant increases in fertility of 13.4 and 15.3 per cent of the cows inseminated, respectively. The 250 and 750 unit concentrations each showed average increases of 8.7 percentage units over the controls and these differences approached significance. Greatest improvement in breeding efficiency was obtained with 1,000 units of penicillin per ml. of diluter.

The variation in results among the bulls indicated that penicillin had a very beneficial effect upon the semen from certain bulls of lowered fertility, while failing to be of significant value when added to the semen of other bulls. Thus, three of the five bulls showed large increases in fertility of 14.5, 21.1 and 31.6 percentage units when 1,000 units of penicillin were added per ml. of diluter. Of the remaining bulls, one showed a small increase of 4.1 per cent while the other showed no beneficial response.

## ACKNOWLEDGMENTS

The author is indebted to R. C. Miller of the Department of Agricultural and Biological Chemistry for his suggestions concerning the statistical analysis

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THE RELATION OF THE CAROTENOID AND VITAMIN A CONTENT  
OF SUMMER MILK TO THE CAROTENOID CONTENT  
OF THE PASTURE HERBAGE

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Numerous reports have established the fact that the vitamin A activity of butterfat follows a definite seasonal trend. In northern climates, the highest values are obtained in summer when green forage is abundantly available with the concentration of carotene and vitamin A decreasing progressively throughout the winter season, the degree depending largely upon the carotenoid content of the roughage consumed (2, 4, 5, 6, 7, 9, 10).

Mitchell and Wise (8) have reported the effects of continual and rotational pasturing of Bermuda grass on the carotene content of the pasture grass and the carotene content of the milk produced therefrom. No marked effect of the systems of grazing was reflected in the carotene content of the herbage or in the carotene content of the milk.

At the Ohio Agricultural Experiment Station on a 60-acre farm devoted entirely to pasture research, a herd of Jersey cows has been used to study various methods of pasturing permanent bluegrass pastures and legume mixtures. As an integral part of this pasture research program, a study was made of the relation of the carotenoid content of the pasture grasses to the carotenoid and vitamin A content of the milk produced on these pastures. The results of this study are presented in this report.

EXPERIMENTAL

During the pasture seasons of 1945, 1946 and 1947, three groups of Jersey cows were used in the pasture experiments. In each pasture period one group (A) was pastured on permanent bluegrass without supplemental hay and another group (B) ate the same pasture plus supplemental hay, fed *ad libitum* in the barn during the time the cows were being milked. A third group (C) was pastured on various legume mixtures without supplemental hay. The bluegrass pastures were well fertilized and contained varying amounts of white clover, depending on the season and weather conditions.

Each year in April, just before the cows were turned out to pasture, a sample of milk was collected from the individual cows of each pasture group. Subsequently, during each pasture period throughout the pasture season, individual milk samples were collected and composited according to morning and evening production and analyzed for vitamin A and carotenoids. Sampling was done as near to the middle of the pasture period as could be anticipated.

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About 4 days prior to the milk sampling date, a "plucked" sample of pasture herbage was taken from the various pasture plots on which the cows were grazing. Information concerning the length of the pasture periods, cow groups, numbers of cows in the groups, description of the pastures, date of milk sampling and date of pasture sampling is indicated in fig. 1 (1945), fig. 2 (1946), and fig. 3 (1947) and the accompanying legends.

Milk carotenoids and vitamin A were determined essentially by the method described by Boyer *et al.* (1), except that hot saponification was used instead of cold. The carotenoids in the pasture were determined according to a procedure developed in the authors' laboratory as a composite of several methods. The

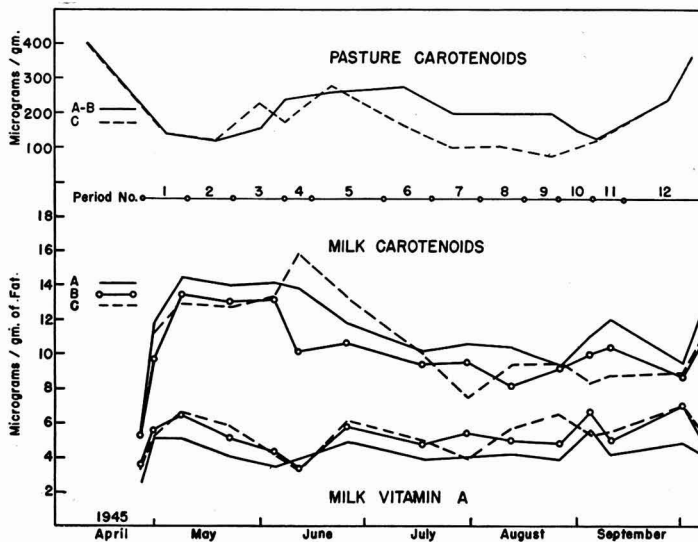


FIG. 1. The relation of the carotenoids in the pasture to the carotenoids and vitamin A content of the milk, 1945. Groups A and B were pastured on bluegrass during periods 1, 2, 3, 4, 5, 6, 7, 8, 9 and 12, on orchard grass in period 10, and on alfalfa-timothy in period 11. Group C was pastured on bluegrass during periods 1, 2 and 12, on alfalfa-timothy in periods 3, 4, 6, 7, 8 and 9, on orchard grass in period 5, and on alfalfa-bromegrass in periods 10 and 11. No. of cows per group was 5.

fresh pasture samples are chopped finely in a Hobart food chopper and a 10-gm. aliquot immediately is weighed, placed in a 250-ml. beaker and covered with acetone. Usually these samples are allowed to stand overnight in a cooler maintained at 40° C; this extracts a large proportion of the pigments. Two 100-g. samples are weighed for the dry matter determination at the same time.

The supernatant acetone then is decanted through a filter paper into a 500-ml. separatory funnel. The sample remaining in the beaker is transferred to a Waring blender and a foam-producing mixture of 2 parts acetone to 1 part

petroleum ether (B.P. 35-60) is added in an amount sufficient to cover the blades of the blender. If a dense foam does not develop when the blender is started, the addition of a few drops of water usually produces the desired results. The foam prevents splashing and possible loss of sample. After about 5 min. of grinding, the extract is decanted through the filter paper and the extraction procedure is repeated on the residue until the green color is extracted. This usually is complete after three to four times.

The petroleum ether fraction containing the green and yellow pigments is separated from the combined extracts by the addition of water to the separatory funnel. The bottom layer containing the acetone is drawn off and the upper

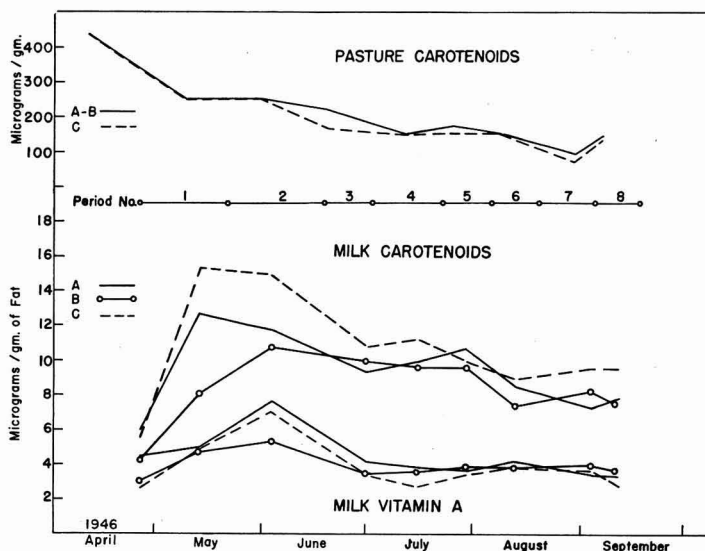


FIG. 2. The relation of the carotenoids in the pasture to the carotenoid and vitamin A content of the milk, 1946. Groups A and B were pastured on bluegrass during periods 1, 3, 5 and 7, on a legume mixture consisting of alfalfa with timothy, bromegrass and ladino clover in periods 2, 4 and 6, and on orchard grass in period 8. Group C was pastured on bluegrass during period 1, on the above legume mixture during periods 2, 4 and 6, on alfalfa, bromegrass and ladino clover in periods 3, 5 and 7, and on alfalfa-timothy in period 8. No. of cows per group was 6.

layer again is washed once with water, care being exercised to prevent the formation of an emulsion. Twenty-five ml. of a previously prepared saturated KOH-methyl alcohol solution then is added and the funnel shaken vigorously. The bottom layer is drawn off and then the process is repeated until this layer is colorless. The yellow top layer is washed three times with water and filtered through  $\text{Na}_2\text{SO}_4$  (anhydrous) into a 100-ml. vol. flask. This crystal clear yellow solution, which contains the carotenoid pigments, then can be read directly or after suitable dilutions in a photoelectric colorimeter using a  $440\text{m}\mu$  filter.

## RESULTS AND DISCUSSION

The data showing the milk carotenoids and vitamin A during barn feeding prior to pasture and at each pasture period throughout the pasture season appear in fig. 1 (1945), fig. 2 (1946) and fig. 3 (1947). Milk carotenoids increased rapidly following the beginning of pasture consumption, usually reaching a peak in early June regardless of the kind of pasture eaten. In 1945 the milk carotenoids leveled off during most of May after a small initial rise. This was due to a cold wet spring in which the pastures stopped growing, resulting in a low carotenoid level of the herbage. Milk vitamin A showed an initial rise and then

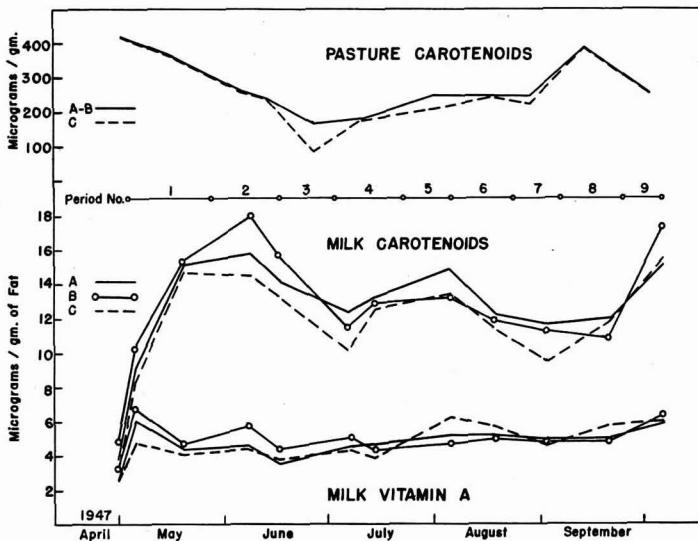


FIG. 3. The relation of the carotenoids in the pasture to the carotenoid and vitamin A content of the milk, 1947. Groups A and B were pastured on bluegrass during periods 1, 3, 5, 7 and 9, and on a legume mixture consisting of alfalfa, bromegrass, ladino clover, and timothy in periods 2, 4, 6 and 8. Group C was pastured on bluegrass during periods 1 and 9, on the above legume mixture in periods 2, 4, 6 and 8, and on a legume mixture of alfalfa, bromegrass, and ladino clover in periods 3, 5 and 7. No. of cows per group was 7.

tended to level off. Changes in the carotenoid content of the pasture herbage were not reflected as markedly in the milk vitamin A as in the milk carotenoids.

It is difficult to determine the level of pasture carotenoids above which no further increase in milk carotenoids and vitamin A is elicited. However, it appears from the data presented that the carotenoids in the milk follow the fluctuations in the carotenoids of the pasture much more closely when the pasture carotenoids fall below about 250  $\gamma$  per g. than at levels above this value.

That the vitamin A level in the milk is subject to less fluctuation due to the intake of carotenoids from the forage is attributed to the influence of the liver

stores and also to the influence of the conversion of carotene to vitamin A. It is of interest in this connection that on numerous occasions the milk vitamin A was observed to increase at the same time the milk carotenoids decreased. This phenomenon has been observed before (2, 3, 10) in studies on blood carotenoid and vitamin A relationships. The appearance of this "inverse" relationship of vitamin A and carotenoids in milk is likely a reflection of similar changes in the blood.

An examination of the milk production curves revealed no indication that the milk carotenoids were influenced markedly by the stage of lactation.

No marked beneficial effect on milk carotenoids or vitamin A levels was attributed to the feeding of supplemental hay in this experiment. This does not mean that under conditions such as extreme drought or sparse grazing the feeding of good quality hay or silage would not increase the vitamin A and carotenoids in the milk.

These data serve to illustrate the fact that, so far as a source of vitamin A activity is concerned, good bluegrass pastures can be equally as good as legume mixtures. This is true provided there is sufficient rainfall and the pastures are managed so as to keep the bluegrass growing rapidly. The superior ability of the legumes to withstand periods of drought causes them to be better sources of carotene than bluegrass under such conditions.

#### SUMMARY

Fluctuations in the vitamin A and carotenoid content of summer milk produced by three groups of cows were related to the fluctuations in the carotenoid content of the pasture herbage consumed during three pasture seasons. The three groups included cows pastured on bluegrass, one group with and one without supplemental hay, and another on legume mixtures, without supplemental hay.

The data illustrate the following: (a) A closer relation exists between pasture carotenoids and milk carotenoids than between pasture carotenoids and milk vitamin A. (b) After the initial rise following the beginning of the pasture season, the fluctuations in milk carotenoids follow the changes in pasture carotenoids more closely when the pasture carotenoids level is below about 250  $\gamma$  per g. than when it is higher, indicating a maximum response at this level. (c) Permanent bluegrass pasture, under weather and management conditions which favor rapid growth, often is equally as good a source of carotenoids as is a pasture consisting of legume mixtures. The superiority of legumes is evident during periods of drought.

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# INFLUENCE OF PENICILLIN AND OTHER ANTIBIOTICS ON LACTIC STREPTOCOCCI IN STARTER CULTURES USED IN CHEDDAR CHEESEMAKING<sup>1</sup>

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In a recent note, Whitehead (17) warned cheese factory patrons that milk from cows infected with bovine mastitis and under treatment with penicillin should not be sent to a cheese factory during the period of treatment and for at least 1 day thereafter, since penicillin has an effect upon starter action. Hunter (6) in a more detailed study of this problem found that *Streptococcus cremoris* strains were inhibited markedly by doses of 0.1 unit per ml., whereas *Streptococcus lactis* strains were more tolerant, being inhibited by 0.25 to 0.3 unit per ml. of milk (as measured by lactic acid production). Essentially, similar results were reported by Hood and Katznelson (5, 7) using a single and a mixed strain starter culture. As little as 0.05 unit per ml. of Na penicillin G gave marked inhibition of acid production. Preliminary tests also indicated that penicillinase inhibited the action of penicillin in milk and permitted acid production. The work reported below represents an extension of these earlier studies with different starters, different antibiotics, individual strains of lactic streptococci and penicillin-resistant starter cultures.

## EXPERIMENTAL PROCEDURE AND RESULTS

The procedure employed in testing the effect of penicillin on acid production by starter cultures has been described in detail elsewhere (5). Pasteurized milk was inoculated with coagulated skim milk cultures of the starters at the rate of 3 per cent, dispensed in 100 ml. amounts in bottles and known amounts of penicillin or of other antibiotics added to each bottle. These were incubated in a water bath at 37° C., 9 ml. amounts being removed hourly and titrated with 0.1 N NaOH. Six starters in all were tested, two being single strain cultures.

The data in table 1 show typical results with four mixed strain starters. Complete inhibition of acid production by all cultures was obtained with 0.5 unit, strong inhibition with 0.1 unit and moderate with 0.05 unit per ml. milk. Similar results were obtained with the single strain cultures.

Five other antibiotics were tested in a similar manner and compared with penicillin; the results are summarized in table 2. Penicillin is the most active substance, with aureomycin and subtilin equal in regard to dilutions giving complete inhibition of growth. However, both penicillin and subtilin cause

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TABLE 1  
Effect of penicillin on acid production in milk by four mixed strain starter cultures

Starter	Penicillin units/ml.	Titratable acidity after incubation for:				
		1 hr.	2 hr.	3 hr.	4 hr.	5 hr.
KAS		(%)	(%)	(%)	(%)	(%)
	0.50	0.20	0.20	0.20	0.20	0.20
	0.10	0.20	0.24	0.32	0.35	0.36
	0.05	0.20	0.25	0.35	0.42	0.45
	0.01	0.20	0.24	0.35	0.46	0.57
	0.005	0.20	0.24	0.35	0.45	0.55
CENT	0	0.20	0.25	0.36	0.47	0.60
	0.50	0.19	0.20	0.20	0.20	0.20
	0.10	0.20	0.24	0.28	0.30	0.31
	0.05	0.20	0.24	0.30	0.37	0.40
	0.01	0.20	0.24	0.31	0.42	0.51
	0.005	0.20	0.24	0.32	0.44	0.55
OAC-H	0	0.20	0.24	0.32	0.44	0.55
	0.50	0.19	0.20	0.20	0.20	0.20
	0.10	0.20	0.25	0.31	0.37	0.39
	0.05	0.20	0.25	0.33	0.46	0.50
	0.01	0.20	0.25	0.33	0.49	0.61
	0.005	0.20	0.25	0.33	0.49	0.61
M	0	0.20	0.25	0.33	0.49	0.61
	0.50	0.20	0.20	0.20	0.20	0.20
	0.10	0.20	0.25	0.30	0.37	0.37
	0.05	0.20	0.26	0.33	0.48	0.53
	0.01	0.20	0.26	0.33	0.54	0.62
	0.005	0.20	0.26	0.33	0.54	0.63
	0	0.25	0.26	0.33	0.54	0.63

inhibition over a wider range of dilutions than do the remainder of the antibiotics. Considerably more chloromycetin and bacitracin are needed to give complete inhibition of starter action; the former appears to be the least effective of all the antibiotics studied, giving no inhibition at a dilution of 1:5,000,000.

Forty-five strains of lactic streptococci were isolated from a starter culture and their sensitivity to penicillin tested in Difco whey broth and in skim milk. Turbidity was used as the index of growth in the former medium and coagulation and/or reduction of pH of the milk (as measured with chlor-phenol red indicator) in the latter medium. Identified cultures of *S. cremoris*,<sup>4</sup> and *Leuconostoc citrovorum*<sup>5</sup> were included in this series. The cultures were less

TABLE 2  
Influence of six antibiotics on acid production in milk by a mixed strain starter culture

Antibiotic	Reciprocal of dilution necessary for:	
	Complete inhibition	No inhibition
Penicillin	3,300,000	166,000,000
Streptomycin	500,000	20,000,000
Aureomycin	1,000,000	20,000,000
Chloromycetin	100,000	5,000,000
Subtilin	1,000,000	100,000,000
Bacitracin	100,000	20,000,000

<sup>4</sup> Supplied by C. E. Parmelee, Iowa State College.

<sup>5</sup> American Type Culture Collection no. 8082.



TABLE 3  
Inhibition of lactic streptococci in whey broth and skim milk by penicillin

Penicillin units/ml.	Strains isolated from starters <sup>a</sup>			
	Whey broth		Skim milk	
	Partial	Complete	Partial	Complete
0.4	.....	45	.....	45
0.2	.....	45	7	38
0.1	5	40	35	8
0.05	14	27	23	0
0.025	18	11	12	0
0.0125	21	3	7	0
0.00625	9	1	4	0
	Identified cultures <sup>b</sup>			
<i>Streptococcus cremoris</i> H1-1	0.05	0.2	0.1	0.4
<i>Streptococcus cremoris</i> ML1	0.05	0.2	0.1	0.4
<i>Leuconostoc citrovorum</i> 531	0.4	1.6	0.8	> 1.6

<sup>a</sup> Number of strains out of 45.

<sup>b</sup> Units penicillin/ml.

sensitive to penicillin in milk than in whey broth (table 3). In the former, all strains required from 0.2 to 0.4 unit penicillin per ml. for complete inhibition; in the latter, most of the cultures were completely inhibited by 0.05 to 0.1 unit, as well, and several even with 0.00625 to 0.0125 unit. The identified cultures fell in the more resistant group of strains both in whey broth and in skim milk; *L. citrovorum* was the most resistant of all the cultures tested.

As has been reported previously (5, 7) the effect of penicillin on starter culture activity was overcome by the addition of penicillinase at the rate of 0.02 mg. concentrate per 100 ml. of milk. The earlier work was repeated and the data condensed as shown in table 4. The enzyme permitted almost normal acid production at a concentration of penicillin (0.5 unit per ml.) which otherwise stopped fermentation completely. Fifty per cent of the total acid produced in the control at 5 hr. was produced with 1.0 unit penicillin per ml. in presence of penicillinase. Cysteine in amounts ranging from 1.0 to 10.0 mg. per 100 ml. of milk did not inactivate penicillin; in fact, the amino acid was somewhat stimulatory in the lower concentrations.

TABLE 4  
Effect of penicillinase on acid production by a mixed strain starter culture in milk containing penicillin

Penicillin units/ml.	% titratable acidity after 5 hr.	
	No penicillinase	With penicillinase
5.0	0.20	0.20
1.0	0.20	0.39
0.5	0.20	0.45
0.1	0.34	0.53
0.05	0.42	0.58
0.01	0.51	0.58
0.005	0.54	0.58
0	0.57	0.58

TABLE 5

*Resistance of penicillin in milk to pasteurization, as determined by acid production by mixed strain starter culture*

Penicillin units/ml.	% titratable acidity after 5 hr.	
	Unpasteurized	Pasteurized
5.0	0.18	0.18
1.0	0.18	0.18
0.5	0.18	0.18
0.1	0.40	0.39
0.05	0.44	0.43
0.01	0.59	0.60
0.005	0.58	0.59
0.0	0.59	0.61

Pasteurization of milk containing penicillin was considered as another means of overcoming the inhibitory effect. Hunter (6) reported that heating milk for 30 min. at 145° F. resulted in very little loss in potency of added penicillin; steaming for 1 hr. resulted in approximately 50 per cent loss. In the present study increasing amounts of penicillin were added to raw milk, one set of bottles was pasteurized for 30 min. at 145° F. and another remained as control. All bottles then were inoculated at the rate of 3 per cent, incubated and sampled as indicated earlier. Results in table 5 show no effect whatever on penicillin activity due to pasteurization and thus corroborate Hunter's findings (6).

Another means of obviating the effect of penicillin is by use of resistant cultures. It is well recognized that bacteria may be adapted to tolerate appreciable amounts of various inhibitory agents by being transferred in increasing amounts of these substances (15). Accordingly, this was done with six

TABLE 6

*Resistance of an "adapted" culture to penicillin before and after subculture in penicillin-free milk*

Penicillin units/ml.	Titratable acidity developed by:		
	Adapted starter	Adapted starter after 20 transfers in penicillin- free milk	Unadapted control starter
	(%)	(%)	(%)
0	0.71	0.82	0.89
0.2	0.70	0.81	0.50
0.4	0.69	0.81	0.23
0.6	0.69	0.83	0.21
0.8	0.69	0.79	0.21
1.0	0.68	0.78	0.21
1.2	0.67	0.83	0.20
1.4	0.60	0.81	0.21
1.6	0.65	0.79	0.20
1.8	0.60	0.77	0.21
2.0	0.66	0.73	0.20
2.2	0.62	0.73	0.21
2.4	0.60	0.65	0.21
2.6	0.61	0.65	0.20
2.8	0.61	0.64	0.20
3.0	0.59	0.62	0.21

starter cultures in sterile skim milk containing penicillin. Coagulation of the milk after overnight incubation at 21° C. was taken as the index of satisfactory development of the starter. One of these starters retained its ability to coagulate milk after daily transfers for 4 mo., the others did not. During this period the culture gradually was adapted to increasing amounts of penicillin, completely coagulating milk with 2.1 units per ml. Since it has been shown that such "trained" cultures can lose their resistance after subculture in absence of the antibiotic (15), the above culture when able to tolerate 1.8 units per ml. was transferred to penicillin-free milk. After six and twenty passages its sensitivity to increasing amounts of penicillin was determined. There was no change whatever in its resistance to penicillin after six transfers in penicillin-free milk and as the results in table 6 clearly show, its resistance remained substantially unchanged even after 20 transfers. In fact, it coagulated milk completely even in the presence of 3.0 units penicillin per ml. of milk, although its acid-producing capacity was appreciably lower at this level. The adapted starter also coagulated milk in the presence of 3.0 units penicillin per ml. and similarly showed a decrease in acid-producing capacity. Its vitality in general was decreasing as compared with the other two starters. The unadapted culture was completely inhibited by 0.4 unit and produced less than 50 per cent of the total acidity with 0.2 unit of penicillin per ml. of milk.

#### DISCUSSION

Although the results presented show considerable variation in penicillin sensitivity among the 45 strains isolated from starter cultures, it is clear that these strains are all completely or partially inhibited by penicillin levels which completely or partially prevent acid formation by the starters themselves. Considerable variation in tolerance exists among the streptococci (2, 14), the enterococci being among the most resistant; according to the results obtained by Hunter (6) and to the data presented above, the lactic streptococci are among the most sensitive.

Other antibiotics such as tyrothricin, bacitracin and streptomycin have also been used for control of bovine mastitis (1, 4). From the point of view of the problem of carry-over of antibiotics into cheese milk the most desirable agent would be one which controlled bovine mastitis and to which the lactic streptococci were most tolerant. Chloromycetin appears to satisfy the latter criterion, being the least potent of the antibiotics tested. Therefore, it remains to be seen if it will be effective in the treatment of bovine mastitis. Little, if any, information is available on the effect of chloromycetin on lactic streptococci; however, 0.63  $\gamma$  per ml. will cause a 50 per cent reduction of growth of *Streptococcus pyogenes* (12).

A very natural question may arise as to the amount of penicillin which might find its way into milk and thus cause trouble. Where only a few animals in an area are under treatment, the dilution of the antibiotic in the pooled milk supply would obviate the difficulty. However, as Hunter (6) and the authors (5, 7) have pointed out, where large numbers of animals in an area are being

treated simultaneously with penicillin the matter of carry-over into cheese milk might be of considerable concern to the cheese manufacturer. Various workers have reported on the concentrations of penicillin in milk from treated quarters, but the amounts which are present in the final, pooled cheese milk are much more difficult to estimate and will vary depending on the amount of penicillin infused, the number of quarters treated, the amount of milk produced by each animal, number of infected animals in a herd, number of animals milked and the volume of milk from treated animals in relation to the total volume of cheese milk. Weirether *et al.* (16) reported that milk contained 0.5 or more O.U. per ml. 24 hr. after infusion of 30,000 or more O.U. per quarter. An analysis of their data shows as much as 10.0 O.U. per ml. 24 hr. after infusion of 40,000 O.U. and about 40 O.U. at 12 hr. Schalm and Casselberry (10) reported that 12 hr. after infusion of 20,000 units per quarter there was an average of 4.95 units per ml. of foremilk in 14 quarters in six udders; with six quarters in three udders an average of 14.29 units per ml. was found. When eight dry quarters each were treated with 100,000 units, there were 5.5 to 29.0 units per ml. of milk 24 hr. afterwards in seven quarters and 0.4 units in one; after 48 hr. seven quarters had 0.7 to 4.7 units per ml. Packer's data (9) indicate an average of 27.8 units per ml. 12 hr. and 2.1 units per ml. 24 hr. after infusion and Hunter (6) arrives at a figure of 5 units per ml. as a conservative estimate after infusion of 25,000 units per quarter with indications of even higher values. Similar wide variations have been reported by other workers (8, 11, 13).

Hunter calculates that 90 gal. of milk with 5 units per ml. in 4,500 gal. (a five-vat factory supply per day) would provide the critical level of 0.1 unit per ml., causing appreciable reduction in acid production. This figure is almost identical with the critical level obtained in the present study causing about 50 per cent reduction of acid production (table 1). On the basis of Packer's data, calculations were made which indicate some of the complications involved and show that the problem can actually arise under certain circumstances.

	Penicillin concentrations	
	12 hr. after infusion (units/ml.)	24 hr. after infusion (units/ml.)
Milk from treated quarter	27.8	2.1
If 2 quarters treated, pooled milk of 4 quarters	14.0	1.0
If 1 of 5 cows treated, pooled milk	2.8	0.2
If 1 of 10 cows treated, pooled milk	1.4	0.1

It would appear from this hypothetical consideration that in areas where 10 per cent of the animals or more were under treatment, sufficient penicillin might be found in the milk to cause trouble in the cheese factory.

The most serious danger might occur in connection with preparation of starter cultures since milk from one patron usually is used; however, as Hunter points out, careful selection of milk to ensure its coming only from untreated cows would overcome this difficulty. Whitehead (17) suggested that milk obtained from cows during penicillin treatment and for 1 day thereafter be withheld from the cheese factory. This is the simplest means of avoiding trouble

but one which is not likely to appeal to cheese factory patrons. Furthermore, in the light of recent reports on the use of various vehicles, such as mineral oil, water and lanolin derivatives, propylene glycol, etc., designed to sustain penicillin levels in the mammary glands (3), Whitehead's suggestion may be impractical since by these means penicillin has been found in milk 72 hr. after infusion in amounts of 0.4 to 4 units per ml. The use of penicillin-resistant starter cultures would obviate the trouble and preclude loss of milk. Pasteurization is ineffective and addition of impure penicillinase concentrates to cheese milk may be objectionable because of expense, possible toxicity and pure food regulations.

#### SUMMARY

Complete inhibition of acid production by six starter cultures was obtained with 0.5 unit penicillin per ml. of milk, strong inhibition with 0.1 unit and moderate with 0.05 unit.

Penicillin was the most inhibitory of the six antibiotics tested with subtilin next; chloromycetin was the least potent.

All 45 strains of lactic streptococci isolated from starter cultures were completely inhibited by penicillin in skim milk in amounts ranging from 0.2 to 0.4 unit per ml. In whey broth most of the cultures were completely inhibited by 0.05 to 0.1 unit; several were sensitive to 0.00625 and 0.0125 unit. A culture of *Leuconostoc citrovorum* tested required 1.6 units for complete inhibition.

Penicillinase at the rate of 0.02 mg. per 100 ml. of milk permitted almost normal acid production by a starter at a concentration of penicillin (0.5 unit per ml.) which stopped fermentation completely and permitted 50 per cent acid production in the presence of 1.0 unit per ml.

Cysteine in amounts ranging from 1.0 to 10.0 mg. per 100 ml. milk was ineffective against penicillin, as was pasteurization.

A penicillin-resistant starter culture was developed which coagulated milk in the presence of 3 units penicillin per ml. and retained its resistance after 20 passages in absence of penicillin.

Calculations are included on the amounts of penicillin which may be found in milk used for cheesemaking.

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## NUTRIENT COMPOSITION OF BANANA SKINS<sup>1</sup>

J. G. ARCHIBALD

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Recently, someone who makes a practice of feeding kitchen and garden refuse to family livestock sent in an inquiry as to the feeding value of such substances. For most of the items mentioned there is considerable information on record, but of the lowly banana skin little is known. The information found was in reports of some analyses made in England and Germany (1, 3), results of one digestion trial with sheep in Germany (2) and an account of a study of the pigments of the banana skin from this country (4), all made many years ago.

Therefore, it was decided to make a rather detailed analysis of the skins. The sample obtained for the work was representative of an entire bunch of the whole fruit. Care was taken in sampling to separate from the skins and discard any pieces of the pulp which either had been overlooked or had been purposely discarded as too ripe for human consumption.

Moisture and carotene were determined in separate portions of the freshly removed skins; the bulk of the sample then was dried rapidly at approximately 80° C. and ground for analysis. The accompanying table gives the values obtained<sup>2</sup> and, for comparison, such other data as are available.

TABLE 1  
*Composition of banana skins*

	Our analyses	Honcamp <i>et al.</i> (2)	Leuscher (3)
	(%)	(%)	(%)
Natural moisture .....	83.8	88.0	70.0
Constituents of the dry matter			
Protein .....	6.1	7.7	9.7
Ether extract .....	8.7	8.1	13.7
Crude fiber .....	10.0	8.6	28.7
Nitrogen-free extract .....	63.1	65.1	34.7
Total sugar (as invert sugar) .....	22.0	.....	.....
Total ash .....	12.1	10.5	13.0
Soluble ash .....	11.7	.....	.....
Calcium .....	.35	.....	.....
Magnesium .....	.23	.....	.....
Sodium .....	trace	.....	.....
Potassium .....	5.72	.....	.....
Phosphorus .....	.32	.....	.....
Sulfur .....	trace	.....	.....
Chlorine .....	.64	.....	.....
Carotene .....	(p.p.m.) 66.0	.....	.....

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<sup>1</sup> Contribution 730 of the Massachusetts Agricultural Experiment Station.

<sup>2</sup> Most of the analyses reported were made in the State Feed Control Laboratory under the supervision of J. W. Kuzmeski, Official Chemist in charge.

There are some rather surprising values here; worthy of special mention are the relatively large amounts of ether extract, sugar, carotene and soluble ash. The ether extract probably carries some indigestible waxy material such as cutin or suberin, but a good deal of this portion doubtless is the familiar banana oil (amyl acetate). The pleasing, characteristic odor of the dried and ground product strongly suggests this possibility. Any material that contains as much as 22 per cent of sugar in the dry matter should not be dismissed as worthless.

The level of carotene is much higher than that reported in the study already referred to (5)—11 p.p.m. in the fresh skins in contrast with about 2.5 p.p.m.; this difference may be due to greatly improved methods for carotene determination, since the work quoted was published in 1929. If the skins were processed in any way, probably a good deal of the carotene would be destroyed, but since most of them, if used at all, are offered to farm livestock soon after removal of the edible portion, they can constitute an additional and not inconsiderable source of vitamin A.

The unusual feature of the ash content is the high value for potassium; this, of course, is not significant nutritionally, but is of interest as perhaps indicating the need for liberal use of potash salts in the culture of the banana plant. In view of the role of potassium in starch formation and translocation it is not surprising to find high concentrations of this element in a fruit as predominantly carbohydrate in nature as the banana. Another investigator (1) reports a somewhat higher value for potassium than was found here (7.5 per cent of the dry substance) and the observation has been made that "the high figure for potassium common to [banana] peel and pulp has suggested the collection of banana waste, the ash of which would form a valuable fertilizer" (4). The difficulty in this connection is, of course, the accumulation of a worthwhile tonnage.

There also is the further possibility, subject to the same limitations, of drying and grinding the skins discarded in the manufacture of banana flour, banana flakes, etc. and marketing the product as a constituent of ready-mixed feeds for livestock. If economically feasible, such a disposition of the skins and any cull fruit<sup>3</sup> would be much less wasteful than burning them to recover the ash. Although not in a class with the standard cereal grains and many of the feed concentrates, it has been shown (2) that banana skin meal has a nutrient value of approximately 56 per cent, which is comparable with a very good grade of hay, and somewhat above much of the hay ordinarily fed to livestock and certain industrial by-products now being used as ingredients of some ready-mixed feeds.

<sup>3</sup> The nutritive value of the product would be increased in direct proportion to the amount of cull whole fruit included.



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# JOURNAL OF DAIRY SCIENCE

## ABSTRACTS OF LITERATURE

Prepared in cooperation with the  
International Association of Ice Cream Manufacturers  
and the Milk Industry Foundation

### BOOK REVIEWS

**773. Monographs on the progress of research in Holland during the war. Chemical and physical investigations on dairy products.** H. EILERS, R. N. J. SAAL and M. VAN DER WAARDEN. Elsevier Publishing Co., Inc., New York, N. Y. 215 pp. \$4.00. 1947.

This monograph, the 12th of the series which Elsevier is publishing on various aspects of Dutch research during the war, contains 3 treatises summarizing the results of investigations on the chemistry of dairy products which were carried out by the Amsterdam Laboratory of the N. V. de Bataafsche Petroleum Maatschappij at the instigation of the General Netherlands Dairy Union. These results previously had been published in somewhat greater detail in Dutch by the authors and their associates in *Verslagen Landbouwkundige Onderzoekingen*, vol. 50 and 52. The three topics discussed are: (1) the colloid chemistry of skim milk (Eilers), (2) the oxidation-reduction potential of milk and of butter plasma (Saal) and (3) the chemical processes underlying the deterioration of butter in cold storage (van der Waarden).

Eilers discusses the composition, state, properties and behavior of the colloidal micelles (Ca caseinate-phosphate and serum protein) of skim milk. The discussion of caseinate is by far the better; the section on milk serum proteins shows evidence of lack of access to foreign literature after 1940. Experimental data are presented on the viscosity of skim milk and the effect of heat treatment thereon, which is shown to involve the caseinate micelles and the serum proteins. The behavior of milk upon concentration, both with and without the addition of sugar, is discussed in detail, particularly with regard to viscosity and distribution of phosphate among the phases.

Saal's chapter on oxidation-reduction deals with the factors determining the potential and with the relation of changes in the potential to development of oxidized flavors in milk. The potential of fresh raw milk (average +0.27 v.) is determined principally by the oxygen and ascorbic acid

contents. It is reduced by heat treatment and increased by addition of Cu or Fe salts which also promote oxidized flavor development. The potential of butter plasma is high but its magnitude is not related to flavor of the butter.

Van der Waarden presents evidence that fishy flavors in storage butter arise from oxidative processes, rather than from hydrolysis of lecithin to trimethylamine. Attempts to isolate the off-flavor compound(s) were unsuccessful, although such compound(s) were prepared in a highly concentrated form.

This monograph contains much rather detailed information that should be of considerable interest to workers in the fields covered. It is well-organized and fairly well-written. The translation is not always as smooth as possible and there are a number of errors, particularly in spelling, but these defects do not detract greatly from the value of the book. The paper binding is entirely inadequate. R. Jenness

**774. Practical Dairy Bacteriology.** PAUL R. ELLIKER. McGraw-Hill Book Co., Inc., New York, N. Y. 391 pp. \$4.00. 1949.

This excellent elementary text and reference book presupposes no previous knowledge of either bacteriology or chemistry. The earlier portions of the book are concerned with the simple fundamentals of bacteriology, and subsequent chapters relate these fundamentals to the handling of the various dairy products. Considerable information on the technology of the different dairy products is presented in order that the science may be related intimately to the practice. References to more detailed treatments of the various topics are given at the end of each chapter and add considerably to the usefulness of the book.

The style of writing used presents the material in very understandable form with a minimum of highly technical vocabulary. The illustrations are unusually satisfactory and the captions are much more explanatory than one encounters commonly; however, lack of any indication of magnification factor or other basis of size in or

with the photomicrographs of microorganisms is unfortunate in the opinion of the reviewer. The chapters on "Methods used to determine sanitary quality of milk and milk products" and "Cleaning dairy equipment" probably will be found particularly useful by many, as these presentations fill a definite need in a very satisfactory way.

F. E. Nelson

**775. Annual review of biochemistry**, vol. XVIII. J. M. LUCK, ed. Annual Reviews, Inc., Stanford, Calif. 739 pp. 1949.

The chapters in this edition are: *Biological Oxidations*, by P. W. Preisler and F. E. Hunter, Jr.; *Proteolytic Enzymes*, by E. L. Smith; *Non-oxidative, Nonproteolytic Enzymes*, by K. Myrbäck; *Carbohydrate Chemistry*, by D. J. Bell; *Chemistry of the Lipids*, by J. A. Lovren; *Chemistry of Amino Acids and Proteins*, by H. P. Lundgren and W. H. Ward; *Nucleoproteins, Nucleic Acids, and Derived Substances*, by J. N. Davidson; *Metabolism of the Lipids*, by A. L. Lehninger; *Chemistry of Neoplastic Tissue*, by E. Boyland; *Metabolism of Proteins and Amino Acids*, by A. Neuberger; *Intermediary Metabolism of Phosphorous Compounds*, by F. Lipmann and N. O. Kaplan; *Carbohydrate Metabolism*, by H. G. Wood and V. Lorber; *Mineral Metabolism (Fluorine and Other Trace Elements)*, by J. F. McClure; *Chemistry of the Hormones*, by A. Wettstein and F. Benz; *Fat Soluble Vitamins*, by P. L. Harris; *Water Soluble Vitamins*, by E. L. R. Stokstad and T. H. Jukes; *Nutrition*, by A. Keys; *Metabolic Inhibitors*, by R. J. Winzler; *Chemistry of Antibiotics*, by O. Wintersteiner and J. D. Dutcher; *Insect Biochemistry*, by V. B. Wigglesworth; *Nitrogenous Constituents of Plants*, by A. G. McCalla; *Organic Acids of Plants*, by T. A. Bennet-Clark; and *Mineral Nutrition of Plants*, by C. H. Wadleigh.

These reviews cover material appearing during late 1947 and nearly all of 1948, in many instances. However, where the subject has not been reviewed for some time or where the reviewer has employed an approach different from that used previously, the period covered may be considerably longer and extend back as far as 1940 in several cases. The quality of the reviews is what one has come to expect of this publication, and the same is true of the indices, format, etc. This is a very useful reference volume.

F. E. Nelson

**776. Manuale Lactis**. M. E. SCHULZ and E. VOGEL, ed. Verlag Hans Carl, Nürnberg, Germany (U. S. Zone). 1948.

Nine sections of this publication have been received. Each section contains abstracts of original

articles in that specific field, appropriate subsections being used for further classification. The sections available are: Milch in der Landwirtschaft (Milk in Agriculture), Milch als Nahrungsmittel (Milk as Food), Milch und Milchprodukte (Milk and Milk Products), Milch in der Molkerei (Milk in the Dairy), Butter und Fette (Butter and Fat), Käse (Cheese), Nebenprodukte (By-products), Bau- und Maschinenwesen (Construction and Machinery) and Molkerei-Hilfstoffe (Dairy Supplies). Many of the abstracts are original, while others are copied from other abstracting sources. All abstracts are in German. The literature of the world seems to be covered quite well from the manufacturing side. Some of the articles abstracted date back to 1939 and quite a few war-time articles are included. One observes a number of errors which it is hoped can be reduced in future issues. Appearance of an index will help to make the material more useable. Prices available for the individual sections range from 8.90 to 20.10 German marks. The nine sections available occupy 1085 pages.

F. E. Nelson

**777. The better utilization of milk**. R. C. HUTCHINSON Angus & Robertson, Ltd., Sydney, Australia. 218 pp. 25/-. 1948.

Milk and the various products which are manufactured from it are discussed with particular emphasis upon the influence of the composition of the various products and of the processing operations upon food value. The treatment necessarily is brief because of space limitations, but numerous references to the literature provide ample opportunity for finding more information when the reader so desires. The indexing is very extensive. Although the preponderance of the material covered is Australian or from the British Empire, much data from the United States is included. The book is written well and well printed.

F. E. Nelson

**778. Sugar: its production, technology and uses**. ANDREW VAN HOON. Ronald Press Co., New York, N. Y. ix + 155 pp. \$3.00. 1949.

The author has presented very well a resumé of the sugar industry in "readable and understandable form the essential facts about the growing, processing and refining of sugar, the scientific basis of its technology, and its many and diverse uses. . . ." In 6 chapters, the subjects of Sugar (its chemical and physical characteristics), Production of Cane and Beet Sugars, Commercial and Trade Aspects, By-Products and History are covered. Over a third of the book is devoted to an interesting description of sugar manufacturing methods.

The book will help those who use sugar in dairy and food products to have an appreciation of its nature and origin. It is written for those with technical knowledge to better appreciate sugar, rather than as a reference on technical properties of sugars, such as they are used in foodstuffs.

K. G. Weckel

779. **Experimental Immunochemistry.** E. A. KABAT and M. M. MAYER. Charles C. Thomas, Springfield, Ill. 567 pp. \$8.75. 1948.

The emphasis is upon laboratory technics for use in the indicated field branching out into related areas with which the field of immunochemistry has common boundaries and in which many of the applicable technics have been developed. The emphasis is upon the quantitative approach, wherever this is applicable. The material is divided into 5 parts: Immunological and immunochemical methodology, Applications and uses of quantitative immunochemical methods, Chemical and physical methods and special procedures used in immunochemistry, Preparations and Appendix. A good index is provided and there are many references to original publications at appropriate places. This volume should prove an excellent reference for all working in the immediate field and to many working in other areas of biological chemistry.

F. E. Nelson

780. C. O. Jensen. **Selected papers.** Vol. I, 1886-1908. M. CHRISTIANSEN and H. O. SCHMIT-JENSON, ed. Einar Munksgaard, Copenhagen, Denmark. 681 pp. (Price not given). 1948.

In addition to a bibliography, 37 original papers (8 published in collaboration with others) are included. Thirteen papers previously not translated to a major language have been translated to English for this publication and 23 originally were published after translation to German, in which language they appear in this publication. The papers are concerned largely with animal diseases, although there are 2 on milk bacteriology and several on special groups of bacteria. Many of these papers would not be available to the majority of the interested people except for this republication. Although the illustrations have suffered somewhat because they had to be reproduced from reproductions, their quality is surprisingly good.

F. E. Nelson

## ANIMAL DISEASES

W. D. POUNDEN, SECTION EDITOR

781. **Studies on repeated vaccination of cattle with *Brucella abortus* strain 19. I. The agglu-**

**tinin response of animals vaccinated as calves and revaccinated as young adults.** D. T. BERMAN and B. A. BEACH, Wis. Agr. Expt. Sta., Madison. *Am. J. Vet. Research*, 10, 36: 208-213. July, 1949.

Three groups of 20 to 22 heifers were vaccinated at 8 mo., 1 group revaccinated at 14 mo. and another group revaccinated at 20 mo. The heifers were managed as a single group. All heifers were bred at 15 to 18 mo. Detailed information as to blood titer and reproductive function was kept. Following revaccination at both 14 and 20 mo., the blood titer rose rapidly to over 1:1,000 and then gradually declined, leveling off at a considerably higher average than found in the singly vaccinated group. All except 1 in each revaccinated group was below 1:100 at the termination of the first pregnancy. Revaccination did not appear to have any deleterious effect on the pregnancy. A virulent *Brucella* infection, not Strain 19, was detected in animals in each group, resulting in some abortions during the observation period. E. W. Swanson

782. **Relation of human and bovine brucellosis in Minnesota.** D. S. FLEMING, Minn. Dept. of Health, Minneapolis, and M. H. ROEFKE, Univ. Farm, St. Paul. *Pub. Health Repts.*, 64, 33: 1044-1051. Aug. 19, 1949.

From 1937 to 1947 the number of reported cases of human brucellosis increased 4- to 10-fold in those districts in Minn. made up of counties not under the area plan of bovine brucellosis control. During this same period there was no appreciable increase in the number of reported cases in the district comprising all 21 counties under an area plan. This difference could not be attributed to fluctuations in cattle population since the relative increase in number of cattle during the war was much the same in all districts. The authors believe that the area plan of bovine brucellosis control is of considerable benefit from the public health standpoint.

D. D. Deane

783. **An epidemiologic study of brucellosis in Minnesota.** R. L. MAGOFFIN, National Institute of Health; P. KOBLER, Minn. Dept. of Health, Minneapolis; W. W. SPINK, Univ. of Minn., Minneapolis, and D. FLEMING, Minn. Dept. of Health, Minneapolis. *Pub. Health Repts.*, 64, 33: 1021-1043. Aug. 19, 1949.

The number of cases of human and bovine brucellosis in Minn. has increased rapidly since the period before World War II. *Br. abortus* was the causative organism in 85% of the 268 human cases studied from Jan., 1945 through June, 1948. The remaining 15% were divided almost

equally between *Br. suis* and *Br. melitensis* and occurred mainly among meat-packing plant employees handling infected swine. Nearly half the cases were found in individuals whose work involved handling livestock or slaughtered animals while about three-fourths had some contact with farm animals. The only source of the infection in about one-fourth of the cases was raw milk. These cases, equally divided between males and females, were more evenly distributed over all ages than those cases caused by animal contact. The agglutinin test was found to be a reliable diagnostic aid in active brucellosis. The authors believe that prevention of the human disease depends upon eradication of the disease in animals.

D. D. Deane

**784. Bovine mastitis associated with beta-haemolytic group C streptococci.** J. C. BUXTON, Vet. Investigation Centre, Sutton Bonington, Leics. *British Vet. J.*, **105**, 4: 107-114. April, 1949.

A brief report is given on 2 outbreaks of bovine mastitis in widely separated herds in which hemolytic group C streptococci were isolated from the milk. In 1 herd of 46 cows treated with penicillin the disease continued to spread. Bacteriological examinations revealed that 41 animals were harboring hemolytic streptococci, 10 of which were group C. The remaining animals were infected with *S. agalactiae*. Each infected animal received 50,000 units of penicillin in 50 cc. of boiled water in all quarters, once daily for 3 d. After 3 d. animals showing streptococci were treated again. *S. agalactiae* was reduced 90%, while only 11% reduction occurred in the animals infected with the group C streptococci. Two further courses of treatment reduced the incidence.

In the second herd of 35 cows, 25 were infected with streptococci. 9 cows with 18 involved quarters showed *S. agalactiae*, while 16 cows with 41 infected quarters showed group C streptococci. The treatment was increased to 100,000 units for 3 d. The quarters infected with *S. agalactiae* were reduced 66%, while 58% of the C group streptococci were clinically cured. It was pointed out that under field conditions *S. pyogenes* mastitis would be difficult to diagnose and heavy infections would fail to respond to ordinary penicillin treatment.

B. B. Morgan

**785. Penicillin ointment in the treatment of chronic bovine mastitis.** A. S. SCHLINGMAN and MARY C. MANNING, Parke, Davis and Co., Detroit, Mich. *Vet. Med.*, **44**, 9: 382-388. Sept., 1949.

Penicillin (calcium salt) was incorporated at the rate of 50,000 units in 3.6 g. of a bland

ointment base in collapsible tubes and used for treatment of a herd of purebred Holstein-Friesian cattle infected with chronic bovine mastitis. Eleven cows involving 25 quarters were treated. Infected quarters were determined by physical examination, strip cup, bacteriological examinations employing bacto-tryptose agar slants, 5% rabbit blood agar plates, Hotis tests and microscopic examinations. Treatment was given at various intervals into all 4 quarters/cow regardless of the number of infected quarters. As a rule, 50,000 units of penicillin ointment was used per quarter, but on several occasions 100,000 units were employed. A range of 1 to 10 treatments was necessary to free 22 of 25 streptococcus- or straphylococcus-infected quarters. Bacteriological examinations were made up to 12 wk. after the last treatment. Three cases of *coli-aerogenes* mastitis were treated with streptomycin with apparently good results. Penicillin in an ointment base was no more irritating to the udder than normal saline or distilled water. Complete protocols are given on all cows treated.

B. B. Morgan

**786. The sensitiveness of pathogenic staphylococci isolated from animals to penicillin.** H. FARRAG, Cairo Veterinary College, Egypt. *British Vet. J.*, **105**, 2: 64-66. Feb., 1949.

The sensitivity to penicillin of 25 cultures of staphylococci isolated from mastitis cows, septic wounds in horses and otitis media in dogs was tested *in vitro*. The test involved the use of a standard inoculum of a 24-hr. broth culture on agar plates containing various units of penicillin. All of the cultures were *Staphylococcus aureus* except 3 which were *S. albus*. All of the strains were found to be penicillin sensitive. In 1 experiment the resistance of straphylococci could be increased artificially up to 220 times, consequently, naturally occurring resistance to penicillin may be encountered.

B. B. Morgan

**787. Human tuberculosis of bovine origin. Its prevention is still an urgent problem.** S. G. TIPPETT, Nordrach-upon-Mendip Sanatorium, Bristol, England. *British Vet. J.* (formerly *Vet. J.*), **105**, 1: 14-18. Jan., 1949.

A brief review of human tuberculosis of bovine origin in England from the medical point of view is given. Only 16% of the cattle in Eng. are certified free from tuberculosis. A recent survey indicated that 1,500 to 2,000 persons die of tuberculosis of bovine origin annually and approximately 4,000 new cases occur every year. Methods used in the U. S. for eradication of bovine tuberculosis and pasteurization of milk were cited as definite proof that the disease can be prevented.

The incidence of tuberculosis in cattle in Eng. may run as high as 35%. A strong appeal was made for community action of livestock owners to demand bovine tuberculosis eradication.

B. B. Morgan

**788. The occurrence of Hypoderma larvae in the spinal canal of cattle.** W. O. HABERMAN, B. B. MORGAN and R. J. DICKE. J. Agr. Research, 78, 12: 637-640. June 15, 1949.

Of 982 larvae removed from 293 infected spinal canals, 975 were identified as *Hypoderma bovis* and 7 as *H. lineatum*. The maximum number of larvae removed from a single infected spinal canal was 21. The length of the larvae ranged from 5 to 17 mm. and a progressive increase in the average length was noted from Sept. (7.5 mm.) to May (15.6 mm.). In Wisconsin, *H. bovis* was found to be most abundant. From other areas *H. lineatum* is more prevalent. Comparable groups of animals indicated a prevalence of *Hypoderma* larvae in the esophageal region. Of 982 larvae removed from infested esophagi, 981 were *H. lineatum* and only 1 was *H. bovis*. Only the larvae of *H. bovis* occurred regularly in the spinal canal and only *H. lineatum* occurred regularly in the esophageal region.

H. Pyenson

Also see abs. no. 780.

## BUTTER

O. F. HUNZIKER, SECTION EDITOR

**789. Production methods and keeping quality of churning cream.** H. R. THORNTON, R. K. SHAW and F. W. WOOD. Can. Dairy Ice Cream J., 28, 5: 54-66. May, 1949.

Sterile utensils are necessary for the production of low bacterial content cream, as well as for low bacterial content of market milk. Special grade may be obtained with twice-weekly delivery when the storage temperature of cream of low bacterial content is 50° F. and with weekly delivery when the storage temp. is not over 45° F. The long storage of such creams at temp. of 50° F. or below probably will result in bacterially-induced flavor defects not now very common in the churning cream industry in Canada. In these circumstances the titratable acidity test may become of very limited value as a differential criterion in grading.

H. Pyenson

**790. Continu boterbereiding volgens het Alfa-procédé.** (Alfa continuous buttermaking process.) (English summary.) Algemeene Nederlandsche Zuivelbond. (General Netherlands Dairy Association.) The Hague, Holland. 30 pp. 1949.

Experience was obtained with apparatus and product of the Alfa continuous process. Cream of about 30% fat content was pasteurized, cooled to 55-60° C. and concentrated to plastic cream with butter composition by a "concentrator", a special Alfa-Laval centrifuge skimming to 0.07% fat. In a "transmutator" the plastic cream was converted into butter. The transmutator is a cooling unit having large diameter screws which transport the cream in a thin layer through three cooled cylinders. In the middle cylinder, usually, the change into butter occurs. Particulars for operating and cleaning are given. The capacity was 400-550 lb./hr. The water content of the butter can be regulated by the concentrator with a cream adjusting screw. Important factors were: skimmilk pressure, number of revolutions, kind of milk, fat content of the 30% cream, concentrating temperature and milk acidity.

The quality of sweet butter was very good; the keeping quality in cold storage and at room temperature was most satisfactory. The consistency was very firm and spreadable. The butter had a low air content and a fine uniform dispersion of the water. Less favorable results were obtained with the artificially flavored product. Alfa butter had a somewhat different quality than ordinary butter, shown both in taste and in structure.

The output was high because the non-fat dry solids content was high and the water content could be adjusted very accurately. The conclusion was drawn that the Alfa process offers promise.

A. F. Tamsma

**791. Whey butter.** LORNE SCHENCK. Can. Dairy Ice Cream J., 28, 8: 42, 76. Aug., 1949.

The same standards of sanitation should apply to whey handling equipment as to that used in handling milk and curd in cheese making. The cream should be pasteurized immediately after the separating. To produce a firm-bodied butter, the cream should be churned at a low temperature and with a reasonably high fat content. Over- and under-churning should be avoided. All the buttermilk must be drained out before salting and working the butter.

H. Pyenson

**792. Butter cutter.** W. GROCOFF. U. S. Patent 2,479,742. 4 claims. Aug. 23, 1949. Official Gaz. U. S. Pat. Office, 625, 4: 1018. 1949.

Butter is cut into rectangular shapes by being pressed through a flanged channel by means of a lever-operated pressure plate.

R. Whitaker  
Also see abs. no. 773, 803, 813, 814, 815.

## CHEESE

A. C. DAHLBERG, SECTION EDITOR

**793. A study of the ripening of Cheshire cheese.** M. BARON, National Institute for Research in Dairying, University of Reading. *Dairy Ind.*, **14**, 7: 705-711. July, 1949.

Eleven Cheshire cheeses of varying quality were studied in detail by rheological and subjective testing during a 2-month ripening period in a well-controlled commercial cheese store (curing room). Despite the small number of samples involved in the experiment, it seems fairly clear that one can distinguish at a very early stage between cheeses of diverse future quality by several rheological tests. The variation of the mechanically measured properties of the cheese during ripening can also be used to give some indication of the type of cheese which is developing.

G. H. Watrous, Jr.

**794. Further studies with lipolytic bacteria and rancid flavors in Cheddar cheese.** E. G. HOOD, C. A. GIBSON and J. F. BOWEN. *Can. Dairy Ice Cream J.*, **28**, 6: 27-28, 82. June, 1949.

An analysis of the results of 11 comparative pairs of vats made from milk containing varying percentages of lipolytic bacteria shows consistently higher acid values and lower flavor scores than uninoculated or control vats. Further evidence is presented to show that the higher the acid value of the cheese fat, the greater is the incidence of unclean and rancid flavor defects. H. Pyenson

**795. Basic research and the cheese industry.** C. W. ABBOTT, Natal Agr. Research Institute, Pietermaritzburg. *Farming in South Africa*, **24**, 279: 306-310. June, 1949.

Preliminary studies have shown that the yield of Gouda and Cheddar cheese per 1,000 lb. of milk is seasonal and follows closely the pattern of seasonal variation in the composition of milk from which it was made. The seasonal influence on Gouda is much more marked than on Cheddar.

F. C. Fountaine

**796. Lack of mould growth in Roquefort cheese.** S. BAKALOR, Agr. Research Institute, Pretoria. *Farming in S. Africa*, **24**, 278: 246. May, 1949.

Mold growth in certain experimental lots of Roquefort cheese was poor or entirely lacking. The pH of such cheese ranged from 4.8 to 6.2 with most samples falling between pH 5 and 6. Cheese with satisfactory mold growth had pH values between 6.25 and 6.75. The author sug-

gests that acidity control should be practiced in the manufacture of Roquefort cheese.

F. C. Fountaine

**797. Consumer preference as related to acidity, curd size, creaming.** W. H. E. REID, Univ. of Missouri, Columbia. *Proc. 41st Ann. Convention Milk Industry Foundation, Plant Sec.*, vol. **2**, p. 21. 1948.

Consumer demand has developed to the point where cottage cheese manufacture must be regarded as a year-round business instead of merely an outlet for surplus milk during the flush period. Uniformity of product is of great importance in building and maintaining a cottage cheese business. Production of cottage cheese increased 250% in the last 14 yr. The product possesses high nutritional values, particularly as an economical source of protein.

"Pop corn" type curd largely has replaced the "smearcase" type of curd, although a few markets still manufacture both types. The optimum acidity of the curd at cutting is 0.57 to 0.63%, or if the whey is tested, 0.45 to 0.50%. The causes of mealiness, lumpiness, and a soft pasty texture are discussed.

Nonfat dry milk solids can be used in cottage cheese manufacture, starting with a product reconstituted in the proportion of 20 lb. nonfat dry milk solids to 80 lb. water. The proper acidity of the curd at cutting varies with the characteristics of the powder but the average value was 0.70%. Two advantages to the use of nonfat dry milk solids for cottage cheese are uniformity of product and availability of raw materials throughout the year to meet market demands for cottage cheese.

D. J. Hankinson

Also see abs. no. 810.

CONDENSED AND DRIED MILKS;  
BY-PRODUCTS

F. J. DOAN, SECTION EDITOR

**798. Whole milk powder made with a minimum of heat treatment.** U. S. ASHWORTH, Dept. of Dairy Husbandry, State College of Wash., Pullman. *Milk Plant Monthly*, **38**, 8: 68-70. Aug., 1949.

The effect of heat on milk and its relation to the keeping quality of whole milk powder is divided into 3 categories: destruction of enzymes, production of antioxidants and reduction of bacterial contamination. Using a review of literature in conjunction with personal observations, the author presents evidence for and against preheating of milk to a high temp. prior to condensing and drying.

J. A. Meiser, Jr.

**799. 6-8-6 Formula produces higher quality bread.** C. A. GLABAU, Bakers Weekly Lab., New York, N. Y. Bakers Weekly, **143**, 9: 34. 1949.

A comparison was made of properties of 2-4-2, 4-6-4, 6-6-6 and 6-8-6 doughs, and breads (Ratios as % M.S.N.F., sugar and shortening, respectively). A complete table of values shows breads of higher percentage ingredients have very favorable properties. K. G. Weckel

**800. Milk—Its contribution to improved bread quality.** C. A. GLABAU, Bakers Weekly, **143**, 11: 36-40. Sept. 12, 1949.

Using a 6-8-6 basic ingredient formula, representing the percentages of non-fat dry milk solids, sugar and shortenings, respectively, experimental breads produced from doughs wherein the M.S.N.F. was varied from 2 to 6% were examined. The study showed increased wt. of dough, bread yield, softness and brownness of color, and reduced baking and cooling loss, and resistance to shear when M.S.N.F. was increased from the lowest level. A complete comparative table is provided. K. G. Weckel

**801. Consumer reaction to bottled fresh concentrated milk.** G. M. TROUT and G. G. QUACKENBUSH. Can. Dairy Ice Cream J., **28**, 7: 68-74, 82. July, 1949.

Bottled fresh concentrated milk concentrated at ratios of 2:1 and 3:1, homogenized and pasteurized, was furnished consumers in order to find out their reactions to the product. Although low temperatures in forewarming were used to keep the formation of heated flavors to a minimum, the cooked type of flavor seemed to predominate in the reconstituted product. Homogenization pressure of 2,000 to 2,500 lb./in.<sup>2</sup> were adequate to maintain satisfactory homogeneity of the reconstituted product. The type of water used was found to be a factor affecting the flavor of the reconstituted milk. The predominating cooked flavor was not objectionable to the majority of the consumers surveyed in the study. The consumers were not interested in buying it regularly unless a saving of 2 to 3¢/qt. of milk equivalent could be effected. H. Pyenson

**802. Method of canning evaporated milk and similar foamy liquids.** G. G. GRINDROD. U. S. Patent 2,477,692. 8 claims. Aug. 2, 1949. Official Gaz. U. S. Pat. Office, **625**, 1: 123. 1949.

To avoid foaming which occurs frequently when evaporated milk is filled into vent-hole type cans, the product is filled hot into the cans which have been deaerated by filling with steam. R. Whitaker

**803. Plastic cream and butter oil.** C. W. DECKER. Can. Dairy Ice Cream J., **28**, 8: 68-76. Aug., 1949.

The article reviews the manufacture of plastic cream and butter oil separately, discussing their development, processing methods and equipment employed, uses, keeping qualities and future possibilities. H. Pyenson

**804. Dry egg composition.** E. K. CHAPIN. U. S. Patent 2,479,310. 2 claims. Aug. 16, 1949. Official Gaz. U. S. Pat. Office, **625**, 3: 775. 1949.

A spray dried egg product having good keeping quality, improved usefulness in baked goods and desirable dispersibility is described. The liquid egg, prior to drying, is mixed with either liquid skim milk or whole milk and an edible fat. R. Whitaker

**805. Preparation of high-grade crude lactose.** E. F. ALMY and O. F. GARRETT. (Assignors to Mand R. Dietetic Laboratories, Inc.) U. S. Patent 2,477,558. 8 claims. Aug. 2, 1949. Official Gaz. U. S. Pat. Office, **625**, 1: 92. 1949.

Lactose solutions, prepared from whey or skim milk, are treated with cationic exchange material in a pH range of 4.6-4.8. The proteins are pptd. by heating to 175-210° F. and removed from the lactose solution. The solution is then demineralized at pH 7.5-9.0 in an anionic exchanger, acidified to 6.5-6.8 and dried. R. Whitaker

Also see abs. no. 876, 877.

## DAIRY BACTERIOLOGY

P. R. ELLIKER, SECTION EDITOR

**806. Comparative analysis of the standard methods methylene blue stain and advantages of the polychrome and acid-and-water-free stains in the direct microscopic examinations of milk.** S. B. LEVINE and L. A. BLACK, U. S. Pub. Health Service, Cincinnati, Ohio. Am. J. Pub. Health, **39**, 9: 1110-1119. Sept., 1949.

The two methylene blue staining solutions recommended in the 9th ed. of Standard Methods (p. 116) differ in both surface tension and dye concentration. Unless the retention of both staining solutions is justified by a comparative study, only 1 should be designated as standard; perhaps the alcohol-containing formula should be given preference. Partial decolorizing of milk films after staining with carbolated methylene blue resulted in counts significantly different (usually higher) than those obtained from the



"undestained" slide. The acid-and-water-free stain yielded the highest counts of all, while the polychrome methylene blue used in this study gave the lowest counts, results with carbolated methylene blue being intermediate. In a previous study, another batch of the polychrome stain had given higher results than carbolated methylene blue. No overstaining occurred with either batch of polychrome stain and the slides were more easily read than those stained by the carbolated methylene blue. Counts of dried milk films stained with the acid-and-water-free stain after 90 d. of storage were not significantly different than those counts obtained after 14 d. of storage.

D. D. Deane

**807. Some factors which influence the thermoduric colony counts of raw milk.** S. B. THOMAS, National Agr. Advisory Service, Trawscold, Aberystwyth. Dairy Ind., 14, 6: 586-589. June, 1949.

No appreciable difference was found in the thermoduric bacterial content of milk produced by hand milking or machine milking on farms where the utensils were efficiently sterilized by steam, boiling water or chlorine.

When the equipment was only washed in warm water, the use of milking machines led to a much higher incidence of excessive thermoduric colony counts.

The proportion of samples with high thermoduric colony counts increased with increasing raw milk counts, though some high count milks had low thermoduric counts.

There was also some association between grading on the routine resazurin test and thermoduric bacterial content.

Thermoduric colony counts on yeastrel milk agar incubated for 4 days at 30° C. were, on the average, 12 times those obtained on yeastrel milk agar incubated for 2 days at 37° C.

G. H. Watrous, Jr.

**808. Controlling thermodurics.** I. E. PARKIN, Penn. State College. Milk Dealer, 38, 10: 64-66. July, 1949; Milk Plant Monthly, 38, 7: 66, 68. July, 1949.

Thermoduric bacteria are discussed as to source and how they get into milk. Eradication may be accomplished by clean methods, clean cows, properly washed and sanitized equipment and managed milking. The latter consists of cleaning the udder, using the strip cup, eliminating hand stripping if machine milking is used, keeping the milk covered and properly cooling and storing the milk until it is shipped. Thermoduric organisms are resistant to heat and sanitizing agents. Rinsing of milk machine equipment

with cold water followed by a hot water rinse after milking therefore is an extremely poor procedure. A method for cleaning and sanitizing milking machines is outlined.

C. J. Babcock

**809. The morphological and cultural characters of the lactic acidoproteolytic cocci.** C. GORINI, Univ. of Milan. Enzymologia XIII, 4: 205-207. 1949.

Characteristics which are considered significant in the differentiation of members of this group of organisms are summarized. The shape of the curd appearing in a litmus milk culture is stressed, and a plate of descriptive diagrams of the curd appearing in typical milk cultures is presented.

J. J. Jezeski

**810. The effect of penicillin on lactic streptococci.** G. J. E. HUNTER, The Dairy Research Institute (N.Z.), Palmerston North, New Zealand. J. Dairy Research, 16, 1: 39-45. Jan., 1949.

The inhibitory effect of penicillin on 10 "single" strains of starter streptococci used in cheese manufacture was studied. *Streptococcus cremoris* strains were inhibited markedly by as little as 0.10 unit of penicillin/ml. of milk. *Streptococcus lactis* strains were not inhibited to the same degree unless 0.25-0.30 unit/ml. was present.

Very little destruction of penicillin occurred in milk pasteurized at 145° F. for 30 min. Steaming the milk for a period of 1 hr. resulted in approximately 50% loss.

The conclusion is that widespread uncontrolled use of penicillin in dairy herds could bring about a real problem in the cheese industry. It would seem advisable to exclude from the milk supply milk from treated quarters.

E. L. Thomas

**811. Coliform—their significance and control in ice cream making.** G. W. SHADWICK, Beatrice Foods Co., Chicago, Ill. Ice Cream Trade J., 45, 8: 44, 87-89. Aug., 1949.

Proper pasteurization of the ice cream mix, thorough cleaning and sanitizing of the equipment, care in handling ingredients and packages, and extreme cleanliness on the part of the worker are necessary if coliform-free products are to be produced.

Coliform bacteria are Gram-negative, non-spore-forming bacteria which ferment lactose with the production of gas. They grow equally well in the presence or absence of air. Since pasteurization destroys coliform bacteria, their presence in dairy products usually indicates recontamination or careless handling and does not necessarily indicate a health hazard, as they are

not pathogenic. Samples taken at various points throughout the plant during processing usually will indicate the point of contamination and make it possible to eliminate the cause of the trouble.

W. H. Martin

**812. The average plate count ratio as a measure with which to judge laboratory work in examining dairy products.** J. L. COURTNEY, Dept. of Public Health, Oak Ridge, Tenn. *J. Milk and Food Technol.*, 12, 4: 197-208. July-Aug., 1949.

A study was made of the av. quantitative plate count on 7,427 samples of raw milk, pasteurized milk, cream, frozen desserts and chocolate beverage at Oak Ridge, Tenn., over a period of 14 mo. An average was determined of the count ratios of those samples for which both dilutions show a range between 30 and 300 colonies. This ratio should not be over 2.0, according to the Standard Milk Ordinance and Code. The average was used as a measure to check the accuracy of the laboratory work.

The av. standard plate count ratio of 2.31 was reduced to 1.85 by minimizing the errors common to pipetting. A carry over of 1 drop on the end of the pipette during plating will contribute to a high average ratio. High average ratios are due primarily to careless laboratory workers and the failure of sanitary officials to use the average as a check on the quality of work done in the laboratory. H. H. Weiser

**813. Some observations on bacterial discoloration of butter.** A. G. LEGGATT. *Can. Dairy Ice Cream J.*, 28, 7: 29-30. July, 1949.

In the 4 cases given it was shown that the trouble was due to carelessness in some part of general plant sanitation. The butter can be infected by 90 lb. butter boxes, parchment wrappers or wooden ware. Contrary to current belief, this discoloration occurred in butter salted at the rate of 2%. H. Pyenson

**814. The nature and quantity of fatty acids produced in butterfat by the action of microorganisms.** T. RICHARDS and G. M. EL-SADEK, University of Reading, Reading, England. *J. Dairy Research*, 16, 1: 46-52. Jan., 1949.

The fatty acids were extracted from 12 samples of rancid butter and fractionated into volatile, solid and liquid groups according to the method of Hilditch. Three samples of butter were made rancid with inoculations of pure cultures of bacteria (*Achromobacterium*, *Micrococcus* and *Pseudomonas* species) and 3 with pure mold

cultures (*Aspergillus*, *Cladosporium* and *Penicillium* species). Six others were obtained in a naturally rancid condition and various species of molds and bacteria were isolated and identified for comparison. The total amounts of acids recovered varied from 0.2 to 1.05% of the total weight of butterfat. In every case the mold samples produced a greater total of fatty acids than did bacteria under identical conditions. The volatile acids constituted from 3.5 to 8.2%, the solid group from 4.3 to 11.2% and the liquid acids from 77 to 85% of the total acids extracted. Bacteria produced relatively less volatile acids than molds but slightly more solid acids. Titration values indicated that bacteria produced a greater proportion of butyric and caproic acids than did molds. No significant difference between bacteria and molds was noted in the production of the liquid unsaturated acids. Iodine values and titration equivalents of the liquid acids indicated a high proportion of oleic and linoleic acids. The suggestion is made that triolein or trillinolein might prove more reliable than tributyrin as a substrate in a medium for the detection of lipolytic bacteria, since these acids appear to make up such a large fraction of the acids recovered from rancid butter.

E. L. Thomas

**815. A method for the bacteriological examination of edible fat preparations.** B. F. CAPPS, M. K. WOLLMAN and N. L. HOBBS. R. P. Scherer Corp., Detroit 13, Mich. *Food Tech.*, 3, 8: 260-263. Aug., 1949.

Standard plate counts on contaminated oil resulted in a dense cluster of colonies around the oil droplets formed on the surface of the agar. In order to eliminate this difficulty, various detergents were tested for their effectiveness in dispersing oil in an aqueous solution to be used in a standard plate count examination. Ten ml. quantities of the aqueous detergent solution of specified concentration were autoclaved in culture tubes with cotton plugs. One ml. of the contaminated oil was added to each tube of detergent solution and the pipette used to mix the inoculum to form an emulsion. The emulsion then was transferred in 1 ml. aliquots to plates and tube media; the plates were poured with the agar medium and after incubation the colonies were counted.

Of the detergents tested, the Tweens showed the greatest advantages. The optimum concentrations were found to be 2% by volume of Tween 80, and 3% by volume of G-2800 in aqueous solution to produce maximum emulsification of the oil with the least unfavorable results.

E. R. Garrison

**816. Inactivation of bacteriophage of the lactic acid streptococci of starters by quaternary ammonium compounds.** C. C. PROUTY, Wash. Agr. Expt. Sta., Pullman, Wash. *J. Milk and Food Technol.*, **12**, 4: 214-218. July-Aug., 1949.

Several quaternary ammonium compounds were effective in the inactivation of bacteriophage. Alkyl di-methyl benzyl ammonium chloride did not inactivate the bacteriophage when used in 100 p.p.m. at 2 and 4 min. exposure periods, although this compound was more effective at lower concentrations than several of the other preparations. N (acyl colamino formyl methyl) pyridium chloride was the least effective in the low concentrations. Based upon U. S. Public Health Service recommendations for Cl<sub>2</sub> solution, a concentration of 200 p.p.m. of a quaternary ammonium compound for a 2-min. exposure should destroy the bacteriophage of the lactic acid streptococci used in cheese starters. H. H. Weiser

**817. Pasteurization effect on bacteria, yeast, molds and enzymes.** P. R. ELLIKER. *Can. Dairy Ice Cream J.*, **28**, 6: 50-60, 88. June, 1949.

The article discusses methods of pasteurizing, time-temperature relationships required for bacterial destruction, effect of pasteurization on various microorganisms in milk and milk products, disease producing bacteria, common lactic acid bacteria, coliform bacteria, rosy milk bacteria, water bacteria, spore formers, molds and yeasts, bacteriophage and antibiotics in cheese milk and effect of pasteurization on enzymes of milk and milk products. H. Pyenson

Also see abs, no. 774, 779, 780, 784, 785, 786, 789, 794, 796, 869.

## DAIRY CHEMISTRY

H. H. SOMMER, SECTION EDITOR

**818. A rapid and simple phosphatase test for milk.** R. ASCHAFFENBURG and J. E. C. MULLEN, National Institute for Research in Dairying, Reading, England. *J. Dairy Research*, **16**, 1: 58-67. Jan., 1949.

The test is based on the use of p-nitrophenyl-phosphate as the substrate. The milk is incubated at 37° C. with a buffered solution of the substrate, followed directly by a visual comparison of the intensity of yellow color of liberated p-nitrophenol with that of boiled milk standards containing known amounts of p-nitrophenol. The presence of 0.2% raw milk could be detected without fail after an incubation period of only

30 min. Upon incubation for 2 hr. the test was sensitive to the presence of 0.1% raw milk. The test was proved sensitive to a drop of 1° F. in pasteurizing temperature (143° F.). Detailed information is given concerning reagents and apparatus required for the test and for the preparation of color standards. Instructions for reading the test by photoelectric colorimetry also are included. E. L. Thomas

**819. A modified Association-Babcock test for homogenized milk.** J. R. BRUNNER, G. M. TROUT and P. S. LUCAS, Dept. of Dairying, Mich. State College, East Lansing. *Milk Plant Monthly*, **38**, 8: 45-46, 48. Aug., 1949.

Since numerous modifications of the Babcock method for testing homogenized milk do not give reliable tests, experiments were conducted to adapt the I.A.M.D. modified Babcock test for buttermilk to the testing of homogenized milk. The testing procedure as finally adopted differed from the original Association test in (a) tempering of the milk and reagents to 60° F., (b) use of 18 g. of milk, (c) addition of 3 ml. of n-butyl alcohol and 14 to 16 ml. of commercial sulfuric acid and (d) use of glymol in reading the test. This procedure gave a clear, curd-free fat column that averaged within +0.05% of the Mojonner method. J. A. Meiser, Jr.

**820. Determination of lactose in milk products.** B. D. HITES, C. W. ACKERSON, and G. H. VOLKMER, Agr. Expt. Sta., Lincoln, Neb. *Analyt. Chem.*, **21**, 8: 993-995. Aug., 1949.

Lactose and sucrose were determined in dairy products by the ferricyanide method, which was shown to be simple, convenient, and time-saving. The method was used for the analysis of dairy products containing lactose and lactose in the presence of sucrose. It cannot be used when the products contain other reducing sugars. Standard lactose and sucrose curves and curves for sucrose plus lactose are presented. A comparison of values obtained by the ferricyanide and copper reduction methods on lactose recovered from whole milk and other common dairy products shows close agreement. B. H. Webb

**821. A conductometric method for the determination of ash in refined lactose.** D. A. BREWSTER and BARBARA A. BREWSTER. *Food Tech.*, **3**, 6: 208-210. 1949.

The conductance method of Zerban and Stattler was adapted so that it could be used for refined lactose. The method outlined is limited to lactose that contains between 0.001 and 0.200% ash. The electrical method is 18% more accurate on

the average than the muffle procedure and is much more rapid and easily performed.

E. R. Garrison

**822. The prooxidant effect of ascorbic acid and cysteine in aqueous fat systems.** DOROTHY A. SCARBOROUGH and BETTY M. WATTS. *Food Tech.*, 3, 5: 152-155. 1949.

A new system for testing antioxidants and synergists in aqueous fat systems was employed. In the absence of added phenolic antioxidants, aqueous solutions of ascorbic acid or cysteine accelerated the oxidation of lard but the accelerating effect of ascorbic acid was not obtained on dry fat. Ascorbic acid inhibited oxidation in aqueous fat systems when 0.01% or more of  $\alpha$ -tocopherol was added.

E. R. Garrison

**823. Denaturation in regenerated protein fibres.** F. HAPPY. *Nature*, 164, 4161: 184. 1949.

By means of X-ray photographs it is shown that the casein in artificially produced fibres is of the  $\beta$  and not of the  $\alpha$  type.

R. Whitaker

Also see abs. no. 773, 794, 881, 882.

## DAIRY ENGINEERING

A. W. FARRALL, SECTION EDITOR

**824. Mechanical can washing.** C. B. SHOGREN. *Can. Dairy Ice Cream J.*, 28, 5: 98-100. May, 1949.

The rules that should be observed in operating any type of straight-line can washer are: (1) keep the washer in a clean, sanitary condition free from lime and deposit, (2) keep the washer in good mechanical condition, (3) an adequate pre-rinse must be maintained with ample water supply and a good line pressure of at least 30-40 lb., (4) fresh solution must be made up daily and sufficient washing compound used to form a heavy foam cap on the wash tank, (5) overflow should be controlled at between 0.5 and 1 U. S. pt./can, (6) treatment should be made to the sterile rinse position to keep pipes and jets in lime-free and clean condition.

H. Pyenson

**825. Lifting device.** F. G. HODSDON. (Assignor to International Harvester Co.) U. S. Patent, 2,480,244. 5 claims. Aug. 30, 1949. *Official Gaz. U. S. Pat. Office*, 625, 5: 1278. 1949.

Milk cans are lifted into and out of milk coolers by means of this device which consists of a vacuum operated reciprocating piston and cylinder and hooks for attaching to the can handles, the

whole being supported by a single pipe vertical frame bolted to both floor and ceiling.

R. Whitaker

**826. Balances milk-chilling water flow by raising supply tank.** M. N. KRAUSE. *Power*, 93, 8: 92-4. Aug., 1949.

A setup for cooling with chilled water circulated through milk and by-products units did not give satisfactory cooling because of an unbalanced flow through the various heat exchangers. The system was changed by installing an insulated supply tank on the 4th floor and new booster pumps. Both manual and automatic controls were installed to operate the pumps. The remodeling made use of the existing circulating pumps and mains wherever possible. The installation was designed and carried through with very little interruption of processing. Graphs of tests and diagrams of the piping and control wiring are presented.

H. L. Mitten, Jr.

**827. Milk can cooler.** R. D. KEMPER. (Assignor to York Corp.) U. S. Patent 2,479,011. 5 claims. Aug. 16, 1949. *Official Gaz. U. S. Pat. Office*, 625, 3: 699. 1949.

Milk in regular milk cans is cooled by placing the cans on racks in this insulated cabinet. Water cooled by a motor driven compressor, set to automatically cool the water to near the freezing point, is sprayed on the cans from distributor pipes. The water collects in a pump below the racks and is circulated back to the cooling unit.

R. Whitaker

**828. Machine for cooling cream.** A. JOHNSON. (Assignor to Land O'Lakes Creameries, Inc.) U. S. Patent 2,480,583. 3 claims. Aug. 30, 1949. *Official Gaz. U. S. Pat. Office*, 625, 5: 1364. 1949.

Cream is cooled by spreading it in a film on horizontally rotating, internally chilled rolls.

R. Whitaker

**829. Water-cooling tower upkeep.** H. E. DEGLER. *Operating Engineer*, 2, 8: 36-7. Aug., 1949.

Makeup water required depends upon losses from evaporation, drift and blowdown. Blowdown water wasted depends upon the hardness of the circulating water, type of softening used and the drift loss. Blowdown is controlled to keep scale-forming solids at such a low concentration that scale does not form.

Additions of  $\text{Cl}_2$ ,  $\text{CuSO}_4$ ,  $\text{KMnO}_4$  and other chemicals will hold or eliminate algae growth so that such formations will not plug nozzles. The

pH of the circulating water should be 7 to 7.5 to prevent delignification of any wooden parts of the tower contacting water. Two-speed motors on the fans of the induced draft towers save power during cold weather or other times when full speed is not required to obtain temperature lowering.

Maintenance consists of seeing that the tower is clean, dirt is removed from catch basin beneath tower, fans are bolted tightly, blades run freely, flexible couplings and universal joints are functioning properly and fans and fan motors are properly lubricated. The catch basin float valve should be adjusted to keep the water level 5 to 6 in. below wood filling. At least 6 in. water should be kept in redwood or steel basins. Nozzles must be kept free of scale and algae. Operation during cold weather requires reduced draft. Icing during periods of sub-freezing weather may be prevented by keeping the water temperature as high as practicable for the equipment served.

A maintenance schedule should be set up and followed.  
H. L. Mitten, Jr.

**830. Refrigerating your ice cream fleet.** Anonymous. *Ice Cream Rev.*, **33**, 1: 48, 50, 52, 53. Aug., 1949.

Truck bodies with a plate type hold-over system account for more than 90% of the current orders, according to results of a survey conducted among the leading manufacturers of this equipment. Over two-thirds of the truck bodies being purchased also have self contained refrigeration units which may be plugged in at an electric outlet wherever the truck may be stationed at night. The practice of using a central ammonia system for supplying the necessary refrigeration for the hold-over plates appears to be in the decline, as only one-third or less of the current orders are for this type of truck body.

Dry ice which was used in about one-third of the ice cream truck bodies 10 yr. ago is now used in less than 2% of them. The use of dry ice for refrigerating ice cream truck bodies has proved to be very expensive in comparison with mechanical refrigeration. Its use is now limited primarily to semi-trailer type trucks making few stops and to vendor units.

A power take-off for supplying continuous refrigeration to ice cream truck bodies is used by only about 1% of the trucks, according to 1 manufacturer.  
W. J. Caulfield

**831. Refrigerated units for trucks is cost reducer.** JOHN HUBEL. *Am. Milk Rev.*, **11**, 9: 36, 37. 1949.

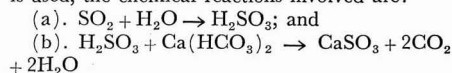
A method used by 1 milk plant is described. Retail delivery trucks are equipped with a

refrigerated cabinet of 36-case capacity. The method of refrigeration is not stated. Advantages claimed for these cabinets are (1) trucks are pre-loaded and ready for the routeman and (2) unsold products are left on the truck and sold the next day, thus eliminating handling and checking in.  
D. J. Hankinson

**832. Liquid sulphur dioxide stops scale in cooling-water systems.** M. E. REINER, E. F. Drew & Co., Inc., 15 E. 26th St., New York City. *Power*, **93**, 8: 86-7. Aug., 1949.

Sulphuric acid can be used to treat industrial cooling water where pH and alkalinity must be lowered. This acid is difficult and hazardous to handle. Sulphur dioxide may be substituted fairly inexpensively. It can be injected as a gas into the makeup water.

Impurities in water are concentrated by the evaporation of water in cooling equipment. Scale is caused by the breakdown of  $\text{CaCO}_3$ . When  $\text{SO}_2$  is used, the chemical reactions involved are:



Use of  $\text{SO}_2$  is limited to those applications where makeup is moderate, for its cost is greater than either sulphur burner gas or  $\text{H}_2\text{SO}_4$ . It is the logical choice where its higher cost is more than balanced by reduced hazards and ease of handling.

Drawings illustrate piping hook-ups for injection, and a table compares costs. H. L. Mitten, Jr.

**833. What plant operators need to know about flue dust.** L. N. ROWLEY and J. C. McCABE. *Power*, **93**, 8: 76-8. Aug., 1949.

Dust differs from smoke in that individual particles of it are large enough to be seen and felt. Most fuels contain some ash. Gas has practically none, oil very little and coal, rarely, has less than 5% and may carry as much as 20-30%. Regardless of how good the burning job is, ash always remains. Some unburned carbon usually accompanies the ash to make flyash or cinder. Flyash particles are smaller than cinder particles; both may be called dust. Dust production cannot be avoided; however, dust scattering and air-pollution from smoke stacks can be eliminated.

With fuel-bed firing by underfeed or traveling grate stokers, the airflow through the fuel-bed carries out the dust. Heavier drafts lift more dust from the bed into the gas stream. Coal plays an important part, since fines increase the carryover and clinkering tends to reduce it. High burning rates also cause more dust carryover, because

rapid burning requires more draft. Pulverized coal with suspension firing presents the most serious flyash problems.

Ordinances usually state the maximum amount of dust to be tolerated in a given amount of flue gas without regard to the amount of air pollution. Sample calculations show that some form of collector is necessary. Seven different types of dust collectors are illustrated. They employ such factors as change of gas velocity, sudden change in direction of gas flow, impingement, centrifugal force, electrostatic precipitation and water washing.

Chimneys can aid in reducing air pollution, for the higher the stack, the greater is the dust travel and diffusion. This is affected by such factors as dust size, local weather conditions and surrounding topography. Chimneys are as much waste-disposal equipment as draft producers.

H. L. Mitten, Jr.

**834. What to look for in a package boiler.** J. F. JOHNSTON, Johnston Bros., Inc., Ferrysburg, Mich. *Operating Engineer*, 2, 8: 24-5. Aug., 1949.

Packaged boilers are automatic units complete with boiler, auxiliaries, controls and instruments. They are assembled and tested at the factory and shipped ready for simple installation.

Advantages are that no special setting is required, no smokestack is necessary, and the complete unit is sold, guaranteed and serviced by a single firm.

Before selecting a packaged boiler determine the actual h. p. load and the hours of use. Packaged unit capacity is rated on the basis of maximum amount of steam that can be generated allowing 34.5 lb. (from and at 212° F.) / boiler h. p. It is safer to buy a packaged unit that can develop your maximum load in lb. of steam / hr. plus a little extra.

Special burners are necessary to burn heavy oil, but heavy oil is lower in cost and has a higher BTU content.

The design of packaged units varies considerably. A careful study of design features and auxiliaries should be made if one is to select a unit that will meet all his demands. The unit must be approved by such organizations as Underwriters Laboratories on electrical devices, National Electrical Code on wiring, ASME code on boiler construction.

A packaged unit requires proper maintenance. There should be a regular periodic interior inspection. Scale and sediment must not be permitted to accumulate. Controls and safety devices should be tested and natural wear and tear corrected.

H. L. Mitten, Jr.

**835. How heating fits into steam costs.** W. SHINN and W. ARROTT, *Operating Engineer*, New York, N. Y. *Operating Engineer*, 2, 8: 27. Aug., 1949.

An illustrative problem is presented and discussed. The problem plant considers heating as a by-product of other steam requirements.

H. L. Mitten, Jr.

**836. Here's how to cut piping operating costs.** G. W. HAUCK, Crane Co., Chicago, Ill. *Heating, Piping & Air Conditioning*, 21, 8: 90-2. Aug., 1949.

Good design places valves in the most convenient locations for operation, but some valves must necessarily be placed where they are relatively inaccessible from the normal level of operators. The amount of time which must be spent in getting to the valve may cumulate costs which need challenging. Valve stem extensions, wheel chains and motor operated valves may effect economies in operational labor. Position indicators eliminate the need for turning the valve stem to determine whether the valve is open or closed. One of the typical ills of the improvised piping installed during recent years is misapplication of valves. Now that correct types are available, valves not properly fitted to the application cannot be justified.

Another common fault is improper suspension of piping. Weight of pipes and fluid can strain joints to the point of leakage, distort valve seats or contribute to maintenance costs in other ways.

H. L. Mitten, Jr.

**837. Pumps need to be piped up right.** H. M. SPRING, Canton, Mass. *Operating Engineer*, 2, 8: 38-39. Aug., 1949.

Piping must be of correct strength for the pressure it will carry. If the shutoff pressure of the pumps exceeds the safe pressure for the discharge pipe, a relief valve is needed. Its discharge should be sufficient to keep the pressure within the safe range.

Where there is a negative suction, an undersized pipe or restriction in the suction pipe can make it impossible for the pump to develop rated capacity. For high-suction lifts, piping one size larger than pump connection should be used. In this case an eccentric reducer should be used to make the connection. The piping layout should be made so that there is no chance for air pockets. Pitch of suction lines should be away from the pump. Temperature of the fluid being pumped affects the effective suction. The higher the temp., the lower the effective suction.

Where there is a positive suction, maintenance is made easier if a valve is installed near the pump. Sharp turns in discharge lines should be avoided with reciprocating pumps. Where hot liquids are handled there must be provision for pipe expansion. Priming of centrifugal pumps for suction lifts may be made with a priming line with shut-off valve to the highest part of the pump casing.

H. L. Mitten, Jr.

**838. Making metal corrosion-resistant.** L. SANDERSON. *Dairy Ind.*, **14**, 7: 721-723. July, 1949.

Zincing, one of the newer methods of making metals corrosion-resistant, can be applied to parts during their manufacture or in service, to water tanks, liquid tanks, containers, etc. by spraying with a gun, by dipping, or with a brush.

Another method of making metal corrosion-resistant is phosphating. In this, Fe, steel, Zn, Al, Cd and their alloys are treated by immersion in a dilute solution of acid phosphate saturated with 1 or more of these metals. This converts the metallic surface into an insoluble crystalline phosphate coating, which is protective and integral with the metallic surface. Phosphate coatings are advantageous when it is desired to produce coatings that withstand corrosion and, also, provide a satisfactory base for paint.

Non-hard drying and hard-drying rust-preventive compounds that are applied to steel to safeguard it against great extremes of temperatures and moisture content in the air are briefly discussed.

G. H. Watrous, Jr.

**839. Fast check for shaft alignment.** E. MARSELLI, St. Louis, Mo. *Operating Engineer*, **2**, 8: 32-3. Aug., 1949.

Flexible couplings should be checked periodically for misalignment. Usually, it is necessary to uncouple the parts for these tests. A simple device is described and illustrated which permits the coupling to remain intact and cuts the checking time to around 10 min. The essential parts are 2 clamps, an indicator rod and a dial indicator. Methods are discussed for checking parallel and angular misalignment with the device.

H. L. Mitten, Jr.

Also see abs. no. 790, 851, 867, 872, 883.

## DAIRY PLANT MANAGEMENT AND ECONOMICS

L. C. THOMSEN, SECTION EDITOR

**840. Cost system for ice cream manufacturers.** JAMES H. GOULD, Business Engineering Council, Rochester, N. Y. *Ice Cream Rev.*, **33**, 1: 39-40, 56-59. Aug., 1949.

A simplified cost accounting system for use in dairy plants is presented and discussed. It is designed to supply management with the essential facts and figures necessary for efficient operation of the business with a minimum of clerical help. Included in the management report are: (1) A monthly summary of total and unit cost figures to make, or to make and sell each product, (2) A plant expense budget showing a comparison of actual expenditures for each account with calculated budget allowance for that account and (3) A profit and loss statement showing the accumulative profit and loss by products for the current accounting period ending with the current month. The latter report also shows variances in the use of raw materials, in the use of labor, in plant expenses and in selling and administrative expenses.

Any plant interested in a simple but comprehensive cost accounting system will find the forms which accompany the article very useful in setting up such a system.

W. J. Caulfield

**841. Industry consumer survey provides data for increasing ice cream sales.** Anonymous. *Ice Cream Rev.*, **33**, 1: 46, 74, 75. Aug., 1949; *Ice Cream Trade J.*, **45**, 8: 32-34, 85-87. Aug., 1949.

In an effort to obtain information which might aid in increasing the sale of ice cream a survey is being conducted by the Am. Dairy Assoc. The present article deals with the preliminary results obtained to date.

It was determined that appetite appeals are the most effective means of advertising ice cream. Refreshing, delicious, variety of flavor, cool and appetizing illustrations were the appeals thought to be most effective. Health and food value appeals were thought to be important by the manufacturers interviewed but only 31 out of 160 dealers considered this type of appeal effective. Quality was thought to be an effective sales appeal by 30 of the 160 dealers interviewed but not 1 of the manufacturers interviewed mentioned this point. Economy appeals were thought to be more effective by dealers than by the manufacturers.

Point-of-sale advertising was favored by 34 of 50 dealers interviewed. Window banners were rated as the most effective type of point-of-sale advertising followed in order by back bar posters, complete bar trim, menu clips-ons, counter cards and over-wire hangers.

Almost half (42.8%) of 1073 families interviewed served ice cream in the home as a dessert. This held true whether there were children in the family or not.

Ice cream as a snack for family members was served by over one-third of the families inter-

viewed. Ice cream was served at parties by 11.9% of the families and on other occasions by 0.7% of all families. Considerable variation between different cities was observed as to the occasions on which ice cream was served.

The use of ice cream in the home by days of the week was found to be as follows: 29.0% of the families interviewed served ice cream on Sat., 22.5% on Fri., 13.3% on Thur., 15.9% on Wed., 12.2% on Tue. and only 5.5% on Mon. Most purchases of ice cream were made between the hours of 4 and 8 p.m.

The housewife made 45.1% of the ice cream purchases, the husband 19.9, a daughter 12.5, a son 11.4, children 4.4 and all others 6.7%.

The place from which ice cream was purchased for family use was found to be as follows: drug store 31.4, grocery 27.7, confectionary 12.5, delicatessen 12.5, ice cream store 10.7, dairy 1.8 and all others 3.4%.

The type of store where ice cream was purchased was selected by 47.4% because of convenience, by 33.3% because of brand preference and 18.9% because of a combination of these 2 factors.  
W. J. Caulfield

**842. Building gallonage through restaurants.** VINCENT M. RABUFFO. *Ice Cream Trade J.*, 45, 8: 28-29, 77-78. Aug., 1949.

In a recent survey 11,000 customers in 138 restaurants were asked to rate ice cream as a dessert. Ice cream was rated most popular, pie a close second, and pie plus ice cream rated almost as high as ice cream and pie individually. Three-fourths of the vote went to these 3 desserts and only one-fourth to all other desserts combined. Sales portfolios prepared for use by restaurant operators point out the advantages of ice cream over other desserts. In addition to being lower in cost, ice cream is ready to serve, always fresh and always available; there is no waste and no left-over problem. At \$1.80/gal., using a no. 16 scoop to dip 28.3 servings, the per portion cost is 0.0633¢, compared to 0.0679 for pie and 0.0643 for cake. With some 525,000 eating places in the U. S., the ice cream industry has an opportunity to step up sales through these outlets.

W. H. Martin

**843. Possible economies in distribution and sale of fluid milk.** G. M. CARLYLE. *Can. Dairy Ice Cream J.*, 28, 6: 32-41, 84. June, 1949.

The following panel discussions were given at the annual meeting of the National Dairy Council of Canada: (1) Every-other-day delivery, by W. F. Jones, (2) Three-day delivery, by E. G. Silverwood, (3) Store differential, by E. A. Lewis, (4)

Other possible economies, by C. E. McMonagle, (5) Tokens, by G. M. Carlyle. H. Pyenson

**844. Business charts an aid to milk plant management.** F. MERISH. *Milk Plant Monthly*, 38, 8: 34-36. Aug., 1949.

Accounting serves both mathematical and statistical purposes, but obtaining statistical information out of columns is a difficult task. Graphs, however, present information in a clear concise manner which can be visualized readily. The several types of graphs available are the pie chart, bar diagram and the line graph. Milk plant operators, both large and small, should use this means of gauging business profitability and managerial ability for themselves and the employees as well.  
J. A. Meiser, Jr.

**845. Keeping costs down.** D. MARKSTEIN. *Milk Plant Monthly*, 38, 8: 58, 61, 65. Aug., 1949.

Interviews with 6 milk plants in New Orleans showed that their methods of holding down costs followed 2 patterns: namely, increasing sales by intensive selling campaigns, reducing small costs and paying close attention to overhead and operating expenses.  
J. A. Meiser, Jr.

**846. Rewarding routemen for steady sales gains.** T. KNIGHT. *Milk Plant Monthly*, 38, 8: 40-41. Aug., 1949.

Each routeman receives a certain bonus for each new qt. of milk over the previous base and this sum is increased each mo. if they keep adding business. Failure to increase sales during 1 mo. automatically causes the routeman to start over and at the lowest bonus rate.  
J. A. Meiser, Jr.

**847. Giving added push to sales drives.** K. STRONG. *Milk Plant Monthly*, 38, 7: 69, 75. July, 1949.

In a drive to get all their customers to use homogenized milk, this plant decided to turn over the 1¢ differential to each routeman who started a customer on homogenized milk and maintained this for 20 d. Progress of this new customer drive was recorded on a large map of the U. S.

Each driver needed 15 extra quarts to ride a paper bull pinned on the map and as his sales increased the animal moved from East to West until the end of the 6-wk. contest. In a later contest paper airplanes were used to chart the progress of the contest.  
J. A. Meiser, Jr.

**848. A "four-way" sales contest.** T. KNIGHT. *Milk Plant Monthly*, 38, 7: 40-41, 48. July, 1949.



In the "4-Leaf Clover" contest credits could be earned 4 ways. Selecting the first 28 d. in Jan. and dividing the sales for that period by two constituted the base period. The contests lasted for 7 consecutive 2-wk. periods. On regular milk sales retail routemen received 1 credit for every 28 qt. over the base period, whereas wholesale routemen had to sell 84 qt. over the base period to receive 1 credit. Homogenized milk credits were set up the same as for regular milk but tabulated separately to increase the sale of both products. An increase of 20 half-pints of coffee or whipping cream netted retail routemen 1 point; wholesale routemen needed 60 half-pints. Finally, an increase of 28 units of by-products netted 1 point for retail routemen; wholesale routemen needed 84 units for the same bonus. At the end of the contest period all sales in the 4 groups listed were totaled and the top routemen awarded prizes.

J. A. Meiser, Jr.

**849. "Carry your carriers" to increase sale of by-products.** P. L. ANDERS. *Milk Plant Monthly*, **38**, 8: 28-29. Aug., 1949.

To offset the loss of regular milk sales during the summer, routemen transported certain by-products to the customers in their carriers. As an incentive to carry these by-products the sales manager visited certain customers on each routeman's route giving them an envelope containing a bonus voucher bearing a cash value of \$2.00 to \$10.00. Customers were instructed to give these envelopes to their routemen only if they came to the door and inquired about selling by-products from the carrier on their arm. For customers' participation free lb. of butter were given. Besides the bonus vouchers picked up by the men the plant offered an added \$100.00 prize to the person selling the most by-products during the 30-d. period.

J. A. Meiser, Jr.

**850. Product costs.** O. M. JOHNSON. *Can. Dairy Ice Cream J.*, **28**, 5: 82-86. May, 1949.

The following reasons prove that product costs indicate whether the business is operating as it should: (1) All selling prices should be based on product costs, (2) Product costs point out the most profitable and least profitable products, (3) Correct valuation of inventories requires product costs, (4) Product costs point out where savings can be made, (5) Locating and stopping plant losses is facilitated through the use of product costs, and (6) Product costs indicate many of the methods necessary to conduct a business profitably. Total and unit product costs can be obtained only when costs and expenses are put together in the cost ledger with the plant reports.

The really pertinent question is not how much it costs to obtain product costs, but can one afford to be without them.

H. Pyenson

**851. Wastes and losses in dairy plant operations.** L. C. THOMSEN, Univ. of Wisc., Madison. *Milk Plant Monthly*, **38**, 7: 26, 28, 30-32, 34. July, 1949.

A list of rules to be followed in the reduction or elimination of losses and wastes in dairy plants would be as follows: (a) obtain representative samples for analysis with the aid of proper sampling equipment and technique, (b) care for samples properly prior to analysis, (c) prepare and analyze samples properly, (d) select proper testing procedures to check the successive stages of your manufacturing operation, (e) install liquid level controls or signals to prevent overflows of milk, (f) check the accuracy of sanitary meters or volume gages that meter the amount of milk on hand, (g) install drip racks to collect drippings from cans, (h) repair leaky pipe lines, valves, etc., (i) check the final product for weight as well as composition, (j) determine the amount of milk waste passing into the waste disposal systems, (k) avoid the general use of water for rinsing milk wastes from the floor and (l) remember that wastes and losses in the plant are not confined to dairy products alone.

J. A. Meiser, Jr.

**852. Improved bill collections.** K. STRONG. *Milk Plant Monthly*, **38**, 7: 62. July, 1949.

Rather than continually remind routemen that their collections are lagging, a board was erected that keeps the men posted. Every routeman who lowers his outstanding bills \$100 over the last base period receives a silver star. If a reduction of \$200 to \$300 is obtained a red star is given. So long as routemen keep getting stars, the company and the individual know that collections are improving.

J. A. Meiser, Jr.

**853. Efficient fleet maintenance.** R. MILLER. *Milk Plant Monthly*, **38**, 7: 58-60. July, 1949.

The following procedures have done much toward simplifying and systematizing fleet maintenance in large plants: (a) routemen must take out and return their trucks to designated places in the garage, (b) all gas and oil placed in trucks must be recorded in triplicate and bear the routeman's signature as proof of delivery, (c) repair sheets are prepared by routeman and the work assigned to mechanics most capable of doing the necessary work, (d) individual record cards are kept for each truck bearing a complete record of operating and maintenance costs and (e) all trucks are given a monthly preventive maintenance inspection.

J. A. Meiser, Jr.

## FEEDS AND FEEDING

W. A. KING, SECTION EDITOR

**854. Digestibility studies with ruminants. XIII. The effect of the plane of nutrition on the digestibility of linseed oil meal.** C. J. WATSON, J. W. KENNEDY, W. M. DAVIDSON, C. H. ROBINSON and G. W. MUIR, Dept. of Agr., Ottawa, Canada. *Sci. Agr.*, 29, 6: 263-272. June, 1949.

Using 6 grade Shorthorn steers, digestibility trials were carried out on 6 rations, 1 of hay, predominantly timothy, fed at the rate of 6.5 kg. and the others of 3 kg. of hay with linseed oil meal at rates varying from 1.0 to approximately 5.0 kg. Supplementary minerals and vitamins were given and the trial periods were arranged in a randomized Latin square set-up. The coefficients of digestibility in % were determined for dry matter, organic matter, nitrogen, ether extract, crude fibre, N-free extract and total carbohydrates and the means for the trials in which the mixed rations were fed were treated statistically.

The level of feeding had no influence on the digestibility of the nitrogen or on the ether extract. As the level increased, the digestibility of the carbohydrate fraction decreased. This decrease was statistically significant in the case of the total carbohydrates, dry matter and organic matter. The loss in TDN over the entire range of feeding was between 2 and 3%. O. R. Irvine

**855. Digestibility studies with ruminants. XIV. The effect of the plane of nutrition on the digestibility of barley.** C. J. WATSON, W. M. DAVIDSON, J. W. KENNEDY, C. H. ROBINSON and G. W. MUIR, Dept. of Agr., Ottawa, Canada. *Sci. Agr.*, 29, 8: 400-408, Aug., 1949.

This is a study duplicating the one described in the previous abstract, except that barley replaced linseed oil meal as the variable component of the ration. As the plane of nutrition increased the coefficients of digestibility decreased, significant differences being obtained in the case of all nutrients tested, i.e., dry matter, organic matter, nitrogen, ether extract, total carbohydrates and gross energy.

The plane of nutrition calculated in terms of maintenance requirements from Brody's formula indicated that the rations ranged from 0.75 to approximately 1.5 times that required for maintenance. O. R. Irvine

**856. Composition and digestible energy of hays fed to cattle.** T. G. PHILLIPS and M. E. LAUGHLIN. *J. Agr. Research*, 78, 10: 389-395. May 15, 1949.

The study was made on 25 samples of hay received from various laboratories in the U. S. These hays served as the sole ration in feeding experiments with cattle; of 18 samples tested there was a close relation between digestible and metabolizable energy. The lignin, protein, cellulose and crude fiber content of the samples all are related closely to their yield of energy but at different levels of these constituents for timothy and alfalfa. The lignin content serves as an excellent means of estimating the digestibility of energy and dry matter. Crude fiber content also is related significantly to the digestibility of energy, but less closely than the lignin content.

H. Pyenson

**857. Carotene retention in alfalfa meal. Effect of moisture content.** G. F. BAILEY, M. E. ATKINS, and E. M. BICKOFF. Western Reg. Research Lab., Albany, Calif. *Ind. Eng. Chem.*, 41, 9: 2033-6. Sept., 1949.

The influence of moisture levels of 0.5 to 26% on the rate of loss of carotene in alfalfa meal was determined under various conditions of storage. It is known that during storage where there is no access to air there is practically no loss of carotene. In alfalfa meal having access to air minimum loss of carotene occurred at a moisture level of about 8%, but only 70 and 25% are retained at 21 and 40° C., respectively, after 90 d. It is suggested that when the seal is broken on sealed samples the carotene is lost rapidly, increasingly so at higher moisture levels. Carotene in alfalfa meal cannot be preserved effectively by controlling the moisture content under conditions of free access to air at temp. above 20° C.

B. H. Webb

## GENETICS AND BREEDING

N. L. VAN DEMARK, SECTION EDITOR

**858. Fructose and citric acid assay in the secretions of the accessory glands of reproduction as indicator tests of male sex hormone activity.** T. MANN, D. V. DAVIES and G. F. HUMPHREY, University of Cambridge, England. *J. Endocrinol.*, 6, 1: 75-85. Apr., 1949.

These studies were conducted with growing male rabbits, bull calves and young bulls. In the bull calves and young bulls, the seminal glands were weighed, examined histologically and analyzed for fructose and citric acid.

In bull calves 3-4 wk. of age, the seminal glands were poorly developed, the fructose content was below 8 mg./100 g. of seminal gland tissue and no citric acid was detected. In bulls 3-4 mo. of age, the seminal glands were enlarged,

there were some histological changes and the fructose values ranged from 42–108 mg./100 g. of tissue. In bulls 6–12 mo. of age, the tubules of the seminal glands were practically all canalized and the fructose content ranged from 95–475 mg./100 g. of tissue. In mature bulls, the seminal glands contained 420–870 mg. of fructose and 520–1120 mg. of citric acid /100 g. of tissue.

Six bull calves were castrated at 3 wk. of age. At the age of 8 mo., 2 of these calves were implanted with pellets of testosterone propionate and all 6 calves were slaughtered at 9 mo. of age. In the non-treated castrates, there was no citric acid in the seminal glands and little fructose. Although the fructose levels of the testosterone-treated castrate calves were not as high as controls of the same age, they did show a 6-fold increase in concentration over that of the non-treated castrates.

Spermatogenesis was first observed in calves 6 mo. old, although no mature spermatozoa were observed until animals were 12 mo. of age. Since the seminal glands function to secrete fructose and citric acid under the influence of testosterone propionate, and since they are both formed in the bull calf before the active appearance of spermatogenesis, the authors conclude that the testicular hormone in the bull begins to function before spermatogenesis.

V. Hurst

**859. The vaginal smear of the cow and causes of its variation.** W. HANSEL, S. A. ASDELL and S. J. ROBERTS, Cornell Univ., Ithaca, N. Y. *Am. J. Vet. Research*, 10, 36: 221–228. July, 1949.

A careful study is reported of the changes in cell types found in the vaginal smear taken from normal cows at various stages in the estrus cycle and from cows treated with diethylstilbestrol and/or progesterone. Five distinct types of epithelial cells were tabulated at each examination and the presence of leucocytes and erythrocytes was noted. During estrus, few cornified cells were found and leucocytes were numerous. The percentage of cornified cells remained low until the eighth or ninth d. when it rose sharply and then remained high until 2 d. before estrus. Smears from ovariectomized heifers were so scanty that examination was unsatisfactory. Diethylstilbestrol-induced heat produced a cell picture very similar to that in a normal heat. Adding progesterone increased the percentage of cornified cells.

E. W. Swanson

Also see abs. no. 860.

#### HERD MANAGEMENT

H. A. HERMAN, SECTION EDITOR

**860. Growth of first generation crossbred dairy calves.** R. A. HILDER and M. H. FOHRMAN. *J. Agr. Research*, 78, 11: 457–469. June 1, 1949.

An analysis was made of the rate of growth of first generation crossbred dairy calves as compared with the growth standards for purebreds. The calves used represented crosses of Holstein, Jersey, Guernsey and Red Dane cattle. The measures of growth used are live weight and a set of 5 skeletal measurements. There is some indication that the crossbreds tend to be slightly larger than the mean of the parent breed averages. Heterosis is indicated in some groups by the fact that the crossbreds are significantly larger than the expected weight or measurement, but this does not hold true for all crossbred calves. Some interesting differences in breed interactions are shown, particularly in the Guernsey crosses.

H. Pyenson

**861. Live-stock watering device.** A. H. HEMKER. (Assignor to General Electric Co.) U. S. Patent 2,479,355. 3 claims. Aug. 16, 1949. *Official Gaz. U. S. Pat. Office*, 625, 3: 787. 1949.

A bowl-shaped drinking fountain for cows, etc., has a treadle within the bowl, which on being depressed admits water to the bowl. The entering water and the water remaining in the bowl when the device is not in use are heated electrically to any controlled desired temperature.

R. Whitaker

**862. The seasonal distribution of calf and milk sales in West Wales and the probable influence of climatic conditions on the rate of calving during the Autumn months and on the consequent milk production.** R. PHILLIPS and J. L. DAVIES, University College of Wales, Aberystwyth. *J. Dairy Research*, 16, 1: 1–13. Jan., 1949.

Data are given which indicate that regional decreases in apparent winter conception rates are significantly similar to corresponding declines both in winter temperatures and in winter sunshine.

E. L. Thomas

#### ICE CREAM

C. D. DAHLE, SECTION EDITOR

**863. Flavor and texture major influence in ice cream buying.** *Ice Cream Trade J.*, 45, 8: 48. Aug., 1949.

Flavor and texture are the 2 main factors which influenced consumers in their choice of brands of ice cream. Richness and smoothness were important to the majority. These and other facts about ice cream consumers' purchasing habits were revealed by a recent survey made in Lexington, Ky., by Merrill DeVoe of the University of Kentucky. Pints were the best sized sales

unit; 4:00 to 7:00 p.m. was the time when most ice cream is purchased for home use; and it is served more frequently for dessert than for a between-meal snack. Eighty-one % of the customers buy take-home ice cream regularly, with the drug store, ice cream and dairy store about equal as a source of supply, followed closely by grocery stores.

W. H. Martin

**864. Stabilizers and emulsifiers, their use in the production of ice cream.** R. B. REDFERN and W. S. ARBUCKLE, North Carolina State College. *Sou. Dairy Prod. J.*, **46**, 3: 30-39. Sept., 1949.

Ice cream mixes containing (a) no stabilizer or emulsifier, (b) stabilizing products (gelatin, Dariloid, Permigel), (c) combination stabilizer and emulsifier products (Vestirine, Freeze-Tex, Dricoid, Gelox, Duo-Lizer) and (d) stabilizer plus emulsifier (gelatin and Dariloid, each with EM 220, Special Na-Pe-Co, Mixacoid, Vis-Ca-Tex, individually) were compared.

The products mentioned had no significant effect upon the pH of the mixes. All of the products increased viscosity. Stabilizer plus emulsifier increased viscosity least. The viscosity of mixes containing stabilizers increased most on aging with the exception of Dariloid mix which did not change viscosity. Stabilizers increased and emulsifiers decreased surface tension. The combination products produced no change and the stabilizers plus emulsifiers, with the exception of Dariloid plus Mixacoid, showed reductions in surface tension. Stabilizers increased the whipping time and emulsifiers decreased it. Stabilizer plus emulsifier decreased whipping time.

The use of emulsifiers resulted in smaller ice crystals and smaller air cells. The stabilizers and combination products increased the rate of melting and stabilizer plus emulsifier decreased melting rate. The combination products caused the ice cream to withstand heat shock best. All the products resulted in greater resistance to heat shock than the controls. Stabilizing and emulsifying agents tended to increase shrinkage, the greatest effect being produced by stabilizer plus emulsifier.

The effects of the use of stabilizers and emulsifiers were greater with batch freezing than with continuous freezing.

F. W. Bennett

**865. Making good ices and sherberts.** C. D. DAHLE. *Can. Dairy Ice Cream J.*, **28**, 8: 27-29, 78-82. Aug., 1949.

Definitions of ices and sherberts, composition, sugars used, sugar and fruits, milk solids, stabilizers, acidity, overrun, freezing, flavoring and defects are discussed.

H. Pyenson

**866. Defects in ice cream and how to cure them.** C. D. DAHLE. *Can. Dairy Ice Cream J.*, **28**, 8: 62-66. Aug., 1949.

The defects reviewed are old material, unclean flavor, cooked flavor, neutralizer flavor, salty taste, sour taste, oxidized flavor, rancid flavor, sogginess, fluffy body, gummy body, crumbly body, coarse texture, buttery ice cream, sandiness, separation and curdiness, failure to melt and shrinkage.

H. Pyenson

**867. Creation of marbled patterns from semifluid substances.** C. C. A. REETZ. (Assignor of one-half to L. A. Bloom.) U. S. Patent 2,479,261. 5 claims. Aug. 16, 1949. *Official Gaz. U. S. Pat. Office*, **625**, 3: 763. 1949.

Ice creams having different flavors or colors are blended continuously in this device as the product leaves the freezer to produce a variegated or marbled effect. The blending is effected by bringing the ice creams together through tubes, one within the other, and mixing into the variegated condition by passage through spiral auger-shaped fins or blades within the single outlet tube.

R. Whitaker

**868. Trends in ice cream packages.** H. W. PICKELL. *Can. Dairy Ice Cream J.*, **28**, 7: 31, 80. July, 1949.

An ice cream product that is easily purchased during shopping trips, an attractive package and a reasonably priced and good quality product are recommended to develop sales.

H. Peyenson  
Also see abs. no. 811, 830, 840, 841, 842.

## MILK AND CREAM

P. H. TRACY, SECTION EDITOR

**869. Significance of milk quality tests.** W. H. CHILSON, Kansas State College Manhattan. *Milk Dealer*, **38**, 10: 82-90. July, 1949.

The acidity test has little value other than a check on the very poorest quality milk. The natural acidity of milk varies from 0.13 to 0.20%; before a measurable acid rise of even 0.01% is evident the bacterial population must increase to at least 10,000,000/cc.

The odor test is much more reliable than the acidity test and as reliable or more reliable than taste. A well-trained man usually can pick out warm milk with a bacterial content of about 1,000,000/cc. and cold milk of 4 or 5 million/cc.

Neither the methylene blue nor the resazurin test is accurate enough for general use on high

quality milk. They are considered accurate on milk containing about 500,000 bacteria/cc or more.

The sediment test does not show much about the quality of milk. It may show clean milk production or just a good straining job on the farm.

The microscopic test is one of the most valuable in controlling the quality of a producer's milk. However, some technicians may over-rate their ability to look in the microscope and tell you just what is the trouble on the farm.

The standard plate count is the laboratory test usually used to determine the bacterial quality of low count raw milk and pasteurized milk. As a general rule it measures a given % of the total bacteria present, and as the number increases, either by contamination or growth, the plate count increases correspondingly.

A thermiduric count may enable the control department to detect unsanitary milking machines, pails, etc., that are not detected by other tests. The coliform test is of little value when used on raw milk. The test is used on pasteurized milk to determine contamination after pasteurization.

The phosphatase test is not a test of the bacterial quality of milk; it determines the presence or absence of the enzyme phosphatase and, therefore, is a test only for proper pasteurization.

The incubation test is a simple practical test to determine how long the milk or cream will keep at room temperature.

The selection of the tests that will be used for a particular milk supply will depend upon type of product sold, money spent for control, personal preference, laboratory facilities, amount of field work to be done and other factors. A test or tests should be selected that will best control the quality of the particular milk supply.

C. J. Babcock

**870. How much is a quart?** A. J. POWERS, Borden's Farm Products, Brooklyn, N. Y. Proc. 41st Ann. Convention Milk Industry Foundation, Plant Sec., vol. 2, p. 54. 1948.

Lack of uniformity exists between states in defining a quart measure of milk. Both the bottle fill-point and temp. of filling should be defined. Some states require filling to the cap seat, other to 0.25 in. below the cap seat, and several states have no fill-point requirement. In 10 states the vol. of liquid measure is specified at 68 to 70° F. When health department regulations concerning bottling temp. are adhered to (generally 50° F.), losses accrue to the milk co. due to the greater wt. of milk at the lower temp. than at 68° F. Milk shrinks 3.30 ml / qt. be-

tween 68 and 40° F. When 10,000 qt./d. are bottled at 40° F., an extra 75.24 lb. of milk are required to reach the fill-point established for 68° F.

D. J. Hankinson

**871. Cream separator.** L. C. COPEMAN. (Assignor to Copeman Laboratories Co.) U. S. Patent, 2,477,863. 4 claims. Aug. 2, 1949. Official Gaz. U. S. Pat. Office, **625**, 1: 167. 1949.

Cream may be removed from a bottle of milk by this device consisting of a cylinder which just slides into the neck of the bottle. It is positioned by a flange located in about the middle of the cylinder, which fits snugly in the cap seat. The top outlet is restricted in size and is closed by the finger tip when device is removed from the bottle.

R. Whitaker

**872. Concentrated sweet cream fat grinder.** J. B. ORRELL. (Assignor to Abbotts Dairies, Inc.) U. S. Patent 2,479,080. 2 claims. Aug. 16, 1949. Official Gaz. U. S. Pat. Office, **625**, 3: 717. 1949.

Blocks of frozen cream are pushed horizontally by a piston against a covered, rapidly rotating fan-like element which shaves the cream and discharges the comminuted material through an outlet below the whirling blades. The shaved cream is defrosted more readily than the original block of frozen cream.

R. Whitaker

**873. Chocolate dairy drink.** E. V. HAMMOND, J. H. MURRAY and W. A. WEIR. Can. Dairy Ice Cream J., **28**, 5: 34-39. May, 1949.

Chocolate dairy drink increases the total consumption of fluid dairy products and, therefore, the total intake of Vit. A is greater. Chocolate dairy drink cannot be said, because of its 4 to 5% sugar content, to be a factor in dental caries. Cocoa taken in the form of dairy drink is not harmful and is recognized as a highly nutritious food.

H Pyenson

Also see abs. no. 806, 807, 808, 818, 819, 825, 826, 827, 831, 843, 844, 845, 846, 847, 848.

## MILK SECRETION

V. R. SMITH, SECTION EDITOR

**874. Experiments on milking technique. 3. Combined effect of reducing the milking time and washing the udder with hot water. 4. Effect of increasing the milking time.** F. H. DODD and A. S. FOOR, National Institute for Research in Dairying, Reading, England. J. Dairy Research, **16**, 1: 14-22. Jan., 1949.

Twenty cows (17 Shorthorn and 3 Guernsey) all in declining lactation were divided into 5 blocks of 4 cows each. During the first 2 wk. the udders of all cows were washed with cold water (approximately 60° F.) about 1 min. before putting on the teat cups. During a 5-wk. experimental period the combined effect of reducing the milking time to 60% of the original flow period and washing the udder with hot water (approximately 120° F.) was studied. During a final 2-wk. period all cows were treated as in the initial control period. The data on milk yield indicate a complete lack of response to the change to washing the udder with hot water. Restriction of milking time to 60% of the original flow period caused an immediate abnormal decrease in yield with no recovery apparent throughout the experiment. A temporary increase in rate of flow resulted from the restriction in milk time; this was explained on the basis of increased udder pressure. The authors pointed out that none of the cows in the experiments was initially slow in letting down its milk and also that the experiments did not cover long-term training to a quicker flow.

In another experiment on 10 cows covering a 16-wk. period, neither the yield and quality of milk nor the rate of milking was affected by leaving the teat cups on at each milking twice as long as was necessary to carry out a normal milking.

E. L. Thomas

## NUTRITIVE VALUE OF DAIRY PRODUCTS

R. JENNESS, SECTION EDITOR

**875. Reviews of the progress of dairy science.** Section D. Nutritive value of milk and milk products. J. Dairy Research, 16, 1: 68-127. Jan., 1949.

This is a comprehensive review covering most of the literature relative to the above field published during the years 1942-1947 inclusive. 913 references.

E. L. Thomas

**876. The effect on the biological value of bread nitrogen of additions of dried skim milk and of soya flour.** K. M. HENRY and S. K. KON, National Institute for Research in Dairying, Reading, England. J. Dairy Research, 16, 1: 53-57. Jan., 1949.

Four lots of bread were baked using 85% extraction flour alone and others supplemented with 6% dry skim milk, 5.56% full-fat soya flour and 3% dry skim milk plus 2.78% soya flour, respectively. The biological values of the proteins

of the breads were determined on rats by the balance sheet method at an 8% level of protein intake. These were, respectively, 56.7, 59.3, 62.6 and 61.9 and the true digestibilities were 91.9, 90.6, 90.9 and 90.8. It was concluded that the soya-flour protein exerted a supplementary effect on the proteins of the plain and of the milk bread, whereas milk proteins showed no such supplementary effect, the effect being only additive; a possible explanation is that milk is known to be deficient in cystine, whereas heating renders the cystine of soya bean available to the animal organism, no deficiency of this amino acid existing in the heated product.

All except 1 of the samples of dry skim milk used possessed abnormally low biological values and hence were apparently deficient in lysine, as has been shown to be the case in deteriorated milk powders. The fact that the 1 sample of dry skim milk with a normal biological value of 81 failed to indicate a supplementary effect on bread protein is the only evidence against the possibility of a lysine deficiency being a factor in the experimental results reported.

E. L. Thomas

**877. The influence of heat-processing on the functional and nutritive properties of protein.** D. MELNICK and B. L. OSER. Food Tech., 3, 2: 57-71. 1949.

Casein, lactalbumin, skim milk, whole milk, dried skim milk, dried whole milk and other proteins were included in this study. It is proposed that the concept of food protein as  $N \times 6.25$  should be extended to include a consideration of both the functional and nutritive properties of the protein. The functional properties affect appearance and palatability of the product and can be evaluated by determining the degree of protein denaturation. The nutritive properties of protein may be determined by animal assay but this data should be supplemented with *in vitro* tests. A procedure for determining the susceptibility of protein to enzymic digestion is given.

The more readily digestible food samples, according to the *in vitro* test, exhibited the higher biological value. Microbiologically available lysine was liberated from heated protein by pancreatin at a much slower rate than from the unheated product. For the optimal utilization of food proteins the essential amino acids all must be available for absorption and they also must be liberated during digestion at rates that permit mutual supplementation.

The formal titration curves of 14 amino acids are shown. A pH of 9.5 was selected as the end-point of the formal titration that gave the most reliable results. The nitrogen content of 18 foods

as determined by formol titration tended to average about 4% less than by the Kjeldahl analysis.  
E. R. Garrison

## PHYSIOLOGY AND ENDOCRINOLOGY

R. P. REECE, SECTION EDITOR

**878. Goitrogenic effect of aminothiazole and reactions of thymus and lymphoid tissue.** C. GREGOIRE, Fondation medicale Reine Elizabeth and Fonds National de la Recherche Scientifique, Brussels, Belgium. *J. Endocrinol.*, 6, 1: 14-22. Apr., 1949.

Male and female white rats ranging in age from 6-8 wk. were used. Animals studied were controls, 2-aminothiazole fed, and those which were incompletely thyroidectomized, incompletely thyroidectomized and given 2-aminothiazole, thyroidectomized, and thyroidectomized plus 2-aminothiazole. The 2-aminothiazole was administered in the drinking water as a 0.1% solution for 21 d. Measurements included the wt. and histology of the thyroids, thymus, spleen and lymph nodes, the wt. of the adrenals, the histology of the kidneys and body growth.

Growth was retarded in all groups except in those rats that were incompletely thyroidectomized. In animals given aminothiazole, the thyroid glands weighed more than 3 times those of the controls on an av. relative wt. basis. Histologically, aminothiazole produced thyroids with high columnar epithelium and devoid of colloid. Thyroidectomy or aminothiazole administration either impaired the growth of the thymus or caused involution to the extent that the thymus glands of these animals weighed only one-half as much as the thymus glands of the controls. Histologically, neither thyroidectomy nor aminothiazole administration caused any striking changes in the splenic tissues. Aminothiazole administration superimposed upon thyroidectomy did not cause a greater change in thymus weights or histology than did thyroidectomy alone. In the dosages administered, no significant changes in wt. or histology of the other glands studied were brought about by aminothiazole administration.

It is suggested that the action of aminothiazole on the thymus is not direct but that it is mediated through the thyroid gland.  
V. Hurst

**879. The Sulkowitch test as a guide in the diagnosis and therapy of bovine hypocalcemia.** D. K. DETWEILER and J. E. MARTIN. Univ. of Penn., Philadelphia. *Am. J. Vet. Research*, 10, 36: 201-207. July, 1949.

The Sulkowitch test for urine Ca has been proposed as a means of differentiating hypocalcemic conditions from others which give similar symptoms. The test is a precipitation of Ca as oxalate at pH 2.6 to 4.5. Cows with hypocalcemia (below 8.4 mg. % serum Ca) usually gave a negative test. Some cases of normal blood Ca were observed with negative Sulkowitch test. Hypercalcemia was always accompanied by a heavy positive Sulkowitch test. Variables such as urine pH, concentration, blood Ca level and manipulation of the test affect the agreement between serum Ca and urine Ca. As a clinical test, it should be of value in preventing Ca injections for animals already hypercalcemic and confirming suspected cases of hypocalcemia before treatment.

E. W. Swanson

**880. Renal excretion following intravenous injection of calcium salts in the normal cow.** A. H. CRAIGE, JR., R. B. JOHNSON, E. G. BLACKBURN and J. M. COFFIN, Univ. of Md., College Park. *Am. J. Vet. Research*, 10, 36: 217-220. July, 1949.

Intravenous injections of 10.5 g. Ca in 500 cc. were given as Ca borogluconate and CaCl<sub>2</sub> to each of 4 normal cows, one lactating. Urine was collected continuously for 1 to 2 hr. before injection and 2 or 3 hr. afterward. Blood samples were taken before injection and 3 min., 1, 2 and 24 hr. post injection. Analyses were made of blood for Ca and P and of urine for rate of excretion, pH, carbonates, NH<sub>3</sub>, Ca, P, Cl, organic acids, creatine, creatinine, volatile phenols, hydroxyacids and residual phenols in order to correlate changes with recovery rate of cows treated for milk fever. Although both Ca compounds are effective in milk fever treatment, their effects on renal excretion were markedly different. A rise in blood and urine Ca and a decrease in urinary output of volatile phenols was common to both treatments. Ca gluconate caused an increased urine volume while CaCl<sub>2</sub> produced a decrease. Diarrhea followed injections of both compounds. No consistent change in P was noted and P was found in urine only in traces.  
E. W. Swanson

**881. Process for producing synthetic thyroprotein.** C. W. TURNER and E. P. REINEKE. (Assignors to American Dairies, Inc. and the Quaker Oats Co.) U. S. Patent 2,478,065. 8 claims. Aug. 2, 1949. Official Gaz. U. S. Pat. Office, 625, 1: 219. 1949.

A protein, such as casein, is iodinated at a temperature of 15-70° C and at a pH of 6.8-10.0 until the Millon test is negative. The iodinated protein is then heated for 12-72 hr. at 50-100° C with MnO as a catalyst.  
R. Whitaker

**882. The fractionation of  $\gamma$ -globulin by electrophoresis-convection.** J. R. CANN, R. A. BROWN and J. G. KIRKWOOD. Calif. Institute of Technol. J. Am. Chem. Soc., 71, 8: 2687-2691. Aug., 1949.

Because of its known heterogeneity and immunological importance, sub-fractionation of  $\gamma$ -globulin, Fraction II of bovine plasma obtained by ethanol fractionation, was attempted by application of the method of electrophoresis-convection. Employing the isoelectric procedure, whereby the protein components successively are immobilized at their respective isoelectric points,  $\gamma$ -globulin was separated into 4 fractions of different mean mobilities and isoelectric points.

Fraction A, representing 45% of the original  $\gamma$ -globulin, corresponds roughly to the bovine  $\gamma_2$ -globulin of Hess and Deutsch. It had a mobility of  $-1.35 \times 10^{-5}$  and an isoelectric point of 7.03, 0.5 pH Unit greater than the mean isoelectric point of  $\gamma$ -globulin. Fraction B appears to correspond to the bovine  $\gamma_1$ -globulin of Hess and Deutsch, which has a mobility of  $-2.1 \times 10^{-5}$ .

The second stage of fractionation of bovine  $\gamma$ -globulin resulted in a top fraction, Fraction C, having a mobility of  $-1.63 \times 10^{-5}$  and an isoelectric point of 6.47. Fraction D, the bottom fraction, had a mobility of  $-2.20 \times 10^{-5}$  and an isoelectric point of 6.01, which is about 0.5 pH unit lower than the mean isoelectric point of  $\gamma$ -globulin. Fraction C represented 19% and Fraction D 36% of the original  $\gamma$ -globulin.

When properly normalized and combined, the gaussian mobility distributions of these fractions yield a mobility distribution in agreement with that of  $\gamma$ -globulin itself. H. J. Pepller

Also see abs. no. 858.

## SANITATION AND CLEANSING

K. G. WECKEL, SECTION EDITOR

**883. Easier and more effective cleaning methods.** JOHN R. PERRY, Sealtest, Inc., New York. Proc. 41st Ann. Convention Milk Industry Foundation, Plant Sec., vol. 2, p. 32. 1948.

Cleaning methods in use in many dairies are described as primitive. The lack of available equipment has prompted the designing of certain appropriate pieces of equipment of importance in efficient cleaning.

Hot water from an electric hot water generator of the reservoir type is mixed with cold water by means of a tempering valve. This water at 115° F. is supplied to all hose stations, each of which is equipped with a pressure regulating valve for supplying no more than the necessary pressure to

perform the cleaning. A special lightweight 0.5 in. creamery hose is provided at the hose stations; this is more economical and at the same time delivers an adequate amount of water. Each hose is equipped with a rubber-covered shut-off valve at the discharge end. The operator can control the water flow without making trips to the hose stations.

Specially designed tanks for cleaning separator and clarifier parts and sanitary fittings make use of rotating brushes to which cleaning solution is fed. Rinsing is accomplished in a separate compartment by means of a foot-controlled spray. A sanitary fitting "buggy" is provided for transporting parts to be washed to the wash sinks. Solution-fed brushes, equipped with long-wearing nylon bristles, are provided for cleaning larger stationary equipment such as coolers, vats, etc. Some types of solution-fed brushes are equipped with a rotating brush, powered by an air turbine.

Improvements in spray equipment for applying chemical sterilizing agents also have been made.

Economies result from decreased labor for cleaning, better cleaning, reduced fuel consumption, lower water usage, lower hose costs, decreased brush expenditures and reduced usage of cleaning compounds. D. J. Hankinson

**884. Acid cleaners—their value and proper use.** C. B. SHOGREN, Klenzade Products, Inc., Beloit, Wis. Proc. 41st Ann. Convention Milk Industry Foundation, Plant Sec., vol. 2, p. 40. 1948.

The conventional alkaline cleaners used for many years possessed certain limitations, chief of which were poor emulsification, peptizing action and rinsing. Hard water likewise imposed a problem. The development of suitable organic acids together with the new wetting agents made possible a cleaning combination which overcame the limitations of the alkaline cleaners. This combination, referred to as an acid cleaner, but more properly called an organic cleaner, possesses one shortcoming in that fat is not effectively removed. Continued use leads to a dark greasy film on equipment.

An effective cleaning program can be followed to take advantage of the beneficial effects of both alkaline and acid cleaners by using both materials but at different times. Under normal conditions an alkaline cleaner is used for 3 days and on the 4th day the acid cleaner is used. With very hard water the acid cleaner should be used every other day. Milk stone is kept under control without resorting to arduous scrubbing to remove built-up deposits. D. J. Hankinson

**885. Combined cleaner-sanitizing agents—their advantages and limitations.** G. J. HUCKER, New



York Agr. Expt. Sta., Geneva. Proc. 41st Ann. Convention Milk Industry Foundation, Plant Sec., vol. 2, p. 44. 1948.

A single compound was sought which would accomplish both cleaning and sterilizing in 1 operation and which also would be effective in cold water. Alkaline cleaners were unsatisfactory because they were not compatible with available sterilizing agents. The wetting agent or anionic type of cleaner was not considered satisfactory because cleaning was not effective and also because the germicidal action of the sterilizing component of the mixture was reduced. The non-ionic group of cleaners was most favorable because of compatibility with sterilizing agents, particularly the quaternary ammonium compounds. However, the non-ionic compounds were not sufficiently effective as cleaners without some modification. The addition of the "proper alkali" is recommended to enhance the cleaning qualities.

Studies with modified non-ionic quaternary mixtures for cleaning milking machines and for use in dairy and food plants indicated very satisfactory performance. Marked reductions in raw counts and thermiduric counts were observed. Washing by flushing with the solution was not effective and led to a slimy condition on certain milking machines. Brushing of rubber parts was recommended. A dispenser which feeds into cold water lines is suggested for dairy plant use to aid cleaning operations.

D. J. Hankinson

**886. Corrosion by commercial sodium hypochlorites and its inhibition.** G. H. BOTHAM and G. A. DUMMETT, A.P.V. Laboratories, London, England. *J. Dairy Research*, **16**, 1: 23-38. Jan., 1949.

Nine samples of commercial hypochlorites were corrosive at 150 p.p.m. available chlorine and 40° C. to metals such as aluminum, tinned copper, nickel silver and cast stainless steel (18 Cr, 8 Cu, 3 Mo). Hypochlorites containing  $\text{KMnO}_4$  when aged were found to attack wrought 18/8 stainless steel.

Sodium silicate added at the rate of 0.25% by vol. to hypochlorites diluted to 150 p.p.m. available chlorine effectively inhibited corrosion of all metals studied, with the exception of aluminum which showed slight attack after 24 hr. contact. The silicate ion apparently exerts a specific effect, since additions of NaOH and  $\text{Na}_2\text{CO}_3$  to the same pH were not effective and actually increased attack on aluminum. Increase of pH from 9 to 10.5 by the addition of either  $\text{Na}_2\text{CO}_3$  or sodium silicate resulted in an equal and significant reduction of bactericidal efficiency of the hypochlorites.

E. L. Thomas

**887. Field testing for quaternary ammonium compounds.** W. K. MOSELY. W. K. Mosely Laboratories, Indianapolis, Ind. *Milk Plant Monthly*, **38**, 7: 76-77. July, 1949.

The object of this investigation was to perfect a rapid, sensitive, yet simple method for determining quantitatively quaternary ammonium compounds in concentrations of 10 to 300 ppm. The resulting test is conducted as follows: to 1 ml. of the solution to be tested is added 0.1 ml. of a 5% citric acid buffer and 1 ml. of standard eosin indicator and the contents shaken until a pink color appears in the lower layer. The contents of the test tube then are titrated with a 0.01% di-octyl sodium sulfosuccinate solution until the red color disappears or becomes white; the ppm. of quaternary compound may then be read from a standard reference curve.

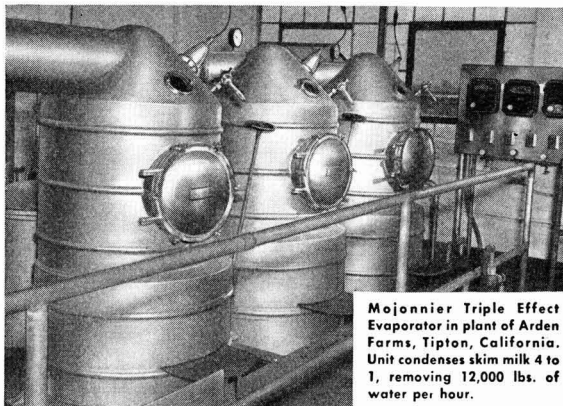
This method was proven accurate for 3 commercial quaternary germicides. Also it could account for all the quaternary compounds added to a 1% skim milk solution. All tests must be as near pH 3.5 as possible if an accurate determination is to be had. A modification of the above method involving paper strips saturated with eosin solution also was perfected and could be used as a rough estimate of the quaternary present.

J. A. Meiser, Jr.

Also see abs. no. 816, 824.

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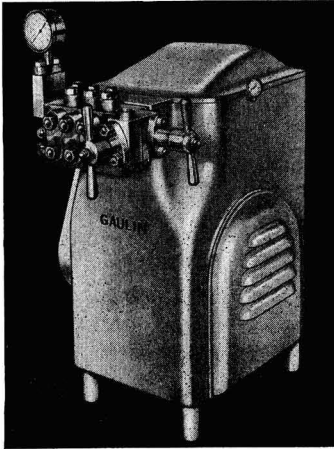
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