DIVISION OF SANITATION

JOURNAL OF DAIRY SCIENCE

แผนกห้องสมุด กรมวิทยาศาสตร์
กระทรวงอุตสาหกรรม

Contents

Vol. XXXIII, No. 8, August, 1950

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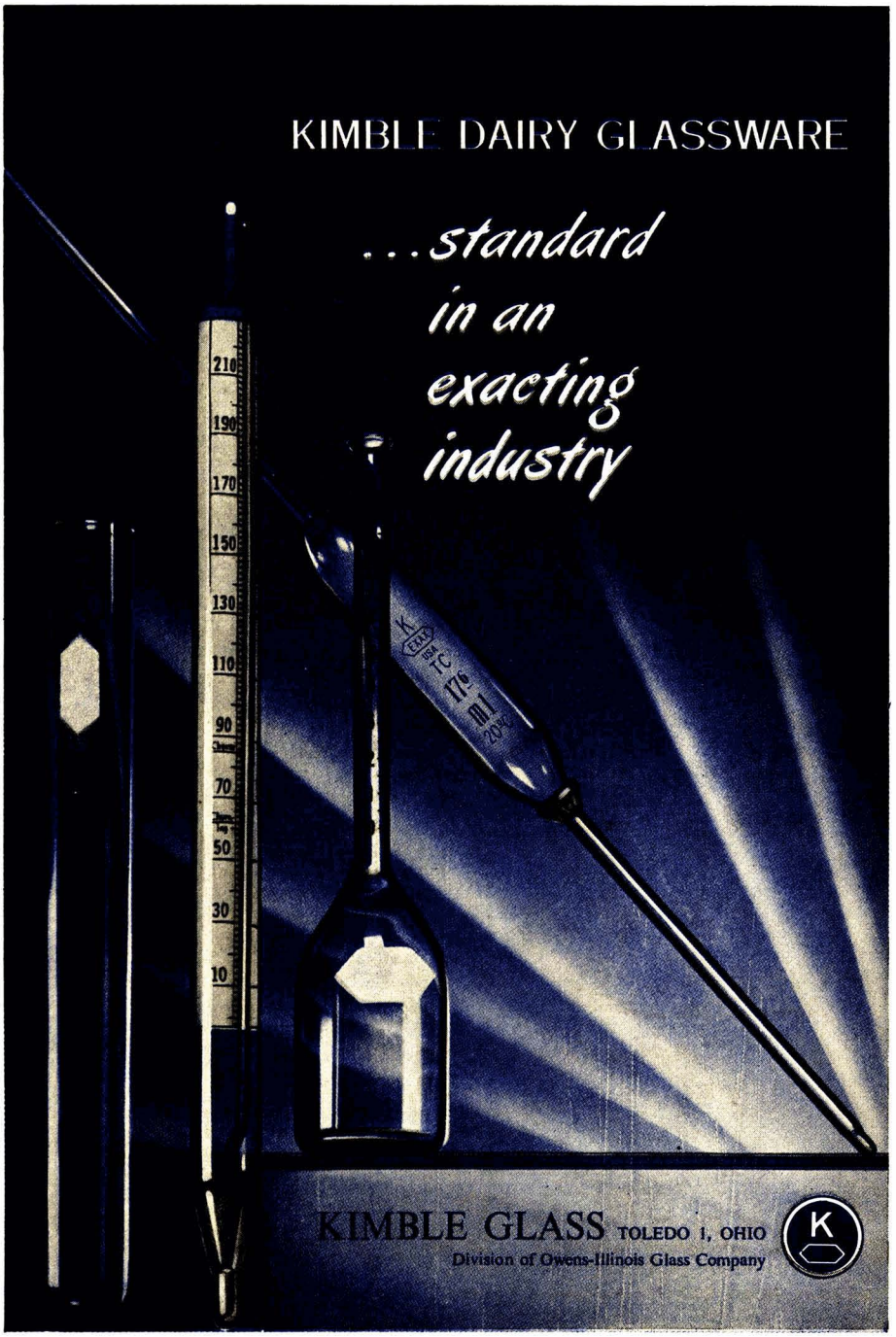

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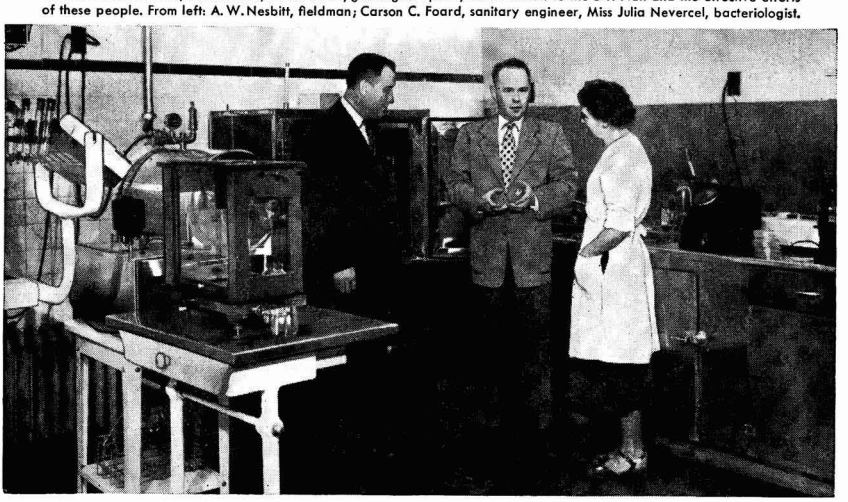

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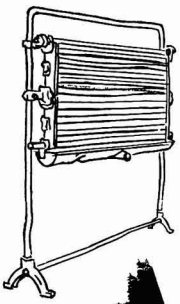

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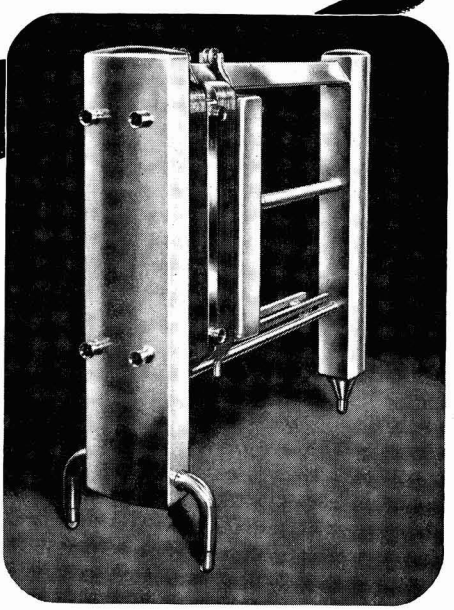

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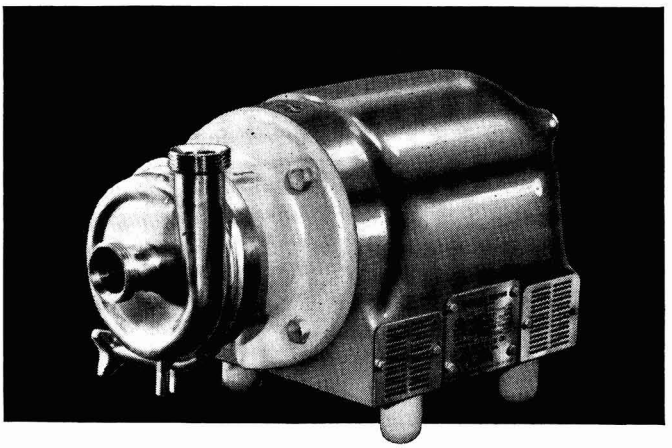

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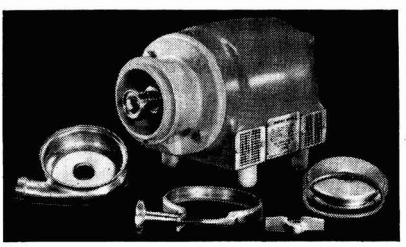

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VOLUME XXXIII AUGUST, 1950 NUMBER 8

THYROPROTEIN FOR LACTATING COWS IN MID-SUMMER

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Since thyroxin stimulates the body metabolic rate, the advisability of feeding thyroprotein to milking cows under hot weather conditions in Louisiana was questioned by Seath *et al.* (12). At environmental temperatures of 93° F. thyroprotein-fed cows showed greater temperature elevation than the controls. Seath noted large body weight losses and attempts to prevent these losses by heavier feeding were only partly successful. Weight losses by cows receiving thyroprotein have been reported by several workers (2, 6, 11, 12). Moore (6) indicated in preliminary observations that approximately 25 per cent additional T.D.N. above Morrison's requirement was needed to maintain body weight and milk flow. The Morrison requirement level to which Moore refers is that "recommended for good cows under usual conditions" (7). Thomas (15) reported from the same laboratory that thyroprotein did not change significantly the gross efficiency for milk production, or the net efficiency when cows were receiving it and were fed at the same level of T.D.N. intake as the controls. However, Thorbek *et al.* (16) in Denmark found that feeding iodized casein to cows increased their heat production 30 per cent and raised the consumption of energy nutrients for milk production by 65 per cent. Increased pulse rates resulting from thyroprotein feeding have been shown by Reineke and Turner (9), as well as others, and increased respiratory rates were reported by Blaxter (2). These physiological reactions of increased respiratory rate, pulse rate and body temperature appear to indicate an increase in heat production and greater effort by the organism to eliminate heat. This extra work occasioned by feeding the compound must result in a reduced gross efficiency of energy utilization unless there are compensatory effects from thyroprotein feeding which increase the net efficiency for milk production.

The purpose of this study was to obtain a more definite measure of the efficiency of feed utilization when thyroprotein was fed in hot weather. In addition to this, it was felt desirable to obtain further knowledge concerning the lactation response and the physiological effects of feeding thyroprotein at several different levels under Mid-west summer conditions.

EXPERIMENTAL

At Urbana, Ill., in the summer of 1947, mean daily temperatures by months were: May, 60° F.; June, 71° F.; July, 76° F.; and August, 82.8° F. In

Received for publication Jan. 23, 1950.

[1] Now at Wallace High-Line Hatchery, Des Moines, Iowa.

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August, the maximum daily temperature exceeded 90° F. on 23 days and 95° F. on 10 days. A double reversal and a continuous trial were conducted to study the effect of thyroprotein feeding upon milk production under such conditions.

Double reversal trial. The double reversal trial, consisting of three 5-wk. periods, was conducted using four cows, one each of the Ayrshire, Brown Swiss, Guernsey and Jersey breeds. The first experimental period began on June 7. Two cows received thyroprotein and two cows acted as controls during each experimental period. Thyroprotein[2] was fed in the concentrate mixture daily at the rate of 1.5 g. per 100 lb. body weight. The cows had been in milk from 4 to 8 mo. and none was pregnant over 8 wk. at the start of the trial. Good quality, first-cutting alfalfa hay was fed at the rate of 2 lb. per 100 lb. body weight or as near that amount as appetites would permit. During the warmest days it was found that hay lost some of its palatability when cows slobbered on it and consumption was improved by more frequent feeding. This hay analyzed 6.38 per cent moisture, 5.84 per cent ash, 1.82 per cent fat, 34.38 per cent fiber and 12.50 per cent total protein. Using Morrison's (8) coefficients of digestibility, the T.D.N. value obtained was 52.6 per cent.

The basal concentrate mixture consisted of 335 lb. ground shelled corn, 285 lb. ground oats, 150 lb. wheat bran, 50 lb. dried brewers' grains, 50 lb. soybean oil meal, 100 lb. linseed meal, 15 lb. steamed bone meal and 15 lb. salt. This mixture contained approximately 73.0 per cent T.D.N. on the basis of Morrison's tables of average composition and digestible nutrients and analyzed 10.22 per cent moisture, 4.91 per cent ash, 4.06 per cent fat, 7.68 per cent crude fiber and 14.56 per cent total protein.

During the first experimental period, the feeding of concentrates to both controls and thyroprotein-fed cows was regulated to provide, along with the hay fed, the amount of nutrients required in the Morrison standard "minimum allowance advised" (8). The T.D.N. requirement for maintenance was calculated on the basis of the weights obtained at the end of the week averaged with the previous weekend weight to give a theoretical mid-week weight. Since the cows fed thyroprotein lost weight rapidly at this rate of feeding, an attempt was made to prevent the loss in the second and third periods by increased concentrate feeding. Accurate records of feed intake were kept.

Cows were stabled during the day and were turned out into a dry lot for the night. Cows were milked by combine milking machine twice daily. All animals were fed in individual, covered mangers and were bedded on wood shavings. The cows were weighed at the same hour on 3 successive days at the beginning of the trial and at the end of each period. They were weighed on 2 successive days at the end of each week. Babcock tests were run weekly on composite samples prepared by taking an aliquot of each milking. Milk was weighed at each milking and milk yields were converted to a 4 per cent fat-corrected milk basis (3).

Blood analyses for serum calcium, phosphorus and magnesium, as well as

[2] The thyroprotein used was "Protamone," furnished by The Cerophyl Laboratories, Inc., Kansas City, Mo.

for blood sugar, were run in the standardization period and late in each experimental period. At least once each week in mid-afternoon, pulse rates and respiratory rates were taken. Blood pressure readings were made on the coccygeal arteries, using a broad cuff sphygmomanometer according to Harshbarger (4). The deflections of the sphygmomanometer needle provided an excellent method of measuring pulse rates. Rectal temperatures were taken twice weekly in mid-afternoon with a clinical thermometer inserted 4 in. into the rectum.

In this reversal type of experiment, the thyroprotein undoubtedly produced carry-over effects of indeterminate length in subsequent periods, not only upon production but upon the efficiency of feed utilization and upon general physiology. As a result, a continuous trial was desirable.

Continuous trial. Eight Holstein cows were placed on a continuous trial beginning on June 28. The cows were divided into three groups. Two animals were used as controls, three received thyroprotein at the rate of 1.33 g. per 100 lb. body weight and three received thyroprotein at the rate of 2.00 g. per 100 lb. body weight. The trial was divided into a 3-wk. preliminary period, an 8-wk. continuous thyroprotein feeding period and a 3-wk. final period. In the final period, two of the thyroprotein-fed cows continued to receive either the 1.33 or 2.00 g. rate, two cows were reduced one-half and two were removed entirely from thyroprotein feeding.

The hay and the concentrate mixture fed were the same as for the reversal trial and all other management and experimental procedures were identical to those described for the double reversal trial.

RESULTS

Double reversal trial. A 32 per cent over-all increase in fat-corrected milk was observed for the four cows receiving thyroprotein at the rate of 1.5 g. daily per 100 lb. body weight. The production per cow averaged by 5-wk. periods is given in table 1 and shows a yield of 752.1 lb. F.C.M. during the periods of thyroprotein feeding, compared with 568.7 lb. while receiving the basal ration alone. During the first 5-wk. period of thyroprotein feeding, all cows showed body weight losses ranging from 26 to 128 lb., although receiving T.D.N. at 99 to 123 per cent of Morrison's minimum requirement. The smallest weight loss was for the cow receiving 123 per cent of her calculated T.D.N. requirement. On the basal mixture alone, the cows gained weight when fed at 105 to 124 per cent of calculated T.D.N. requirement. This difference in weight gain indicated a lowered efficiency of nutrient utilization when thyroprotein was fed.

In order to determine the per cent efficiency of the utilization of T.D.N. available for maintenance and production, the formula given at the bottom of table 1 was developed. Since the energy involved in weight loss became available for maintenance and production along with that in the feed consumed, such weight loss was converted to T.D.N. and added to the T.D.N. of the feed. In the case of body gain, that much T.D.N. became unavailable for maintenance and production and hence was deducted from the T.D.N. consumed. Factors

for converting weight gain or loss into T.D.N. are not considered highly accurate but for comparative purposes may serve as aids. The factors used in this study were those developed by Knott *et al.* (5) and are shown at the bottom of table 1. One pound body gain is considered equivalent to 3.53 lb. T.D.N., while a 1-lb. body loss is considered equivalent to 2.73 lb. T.D.N.

All four cows were relatively less efficient in their use of available T.D.N. during periods of thyroprotein feeding than during the periods when only the basal concentrate mixture was fed. The efficiency of T.D.N. utilization averaged 69 per cent for the thyroprotein periods and 104 per cent during the basal periods. This means that some 31 per cent of the T.D.N. available for main-

TABLE 1

Production response and efficiency of energy utilization in a 15-wk. double reversal trial with thyroprotein fed at the rate of 1.5 g. per 100 lb. body weight

Cow no.	Breed	Ration	Av. F.C.M. yield per period[a]	Total T.D.N. requirement[b]	Total T.D.N. consumption	Weight change in T.D.N.[c]	Efficiency of use of available T.D.N.[d]
			(*lb.*)	(*lb.*)	(*lb.*)	(*lb.*)	(%)
845	A	Thyro	1085.8[e]	1312	1425	−247	78.5
		Basal	908.5	603	645	+173	127.8
901	BS	Thyro	309.8[e]	843	1068	−396	57.6
		Basal	182.1	378	472	+ 18	83.3
926	G	Thyro	799.7	500	578	−120	71.7
		Basal	558.2[e]	859	938	+ 71	99.1
M-59	J	Thyro	813.0	472	577	− 71	72.8
		Basal	626.0[e]	832	941	+177	108.8
Av.		Thyro	752.1	781.6	911.8	−208.5	69.77
		Basal	568.7	667.8	748.7	+109.5	104.47

[a] Fat-corrected milk (3).

[b] Morrison's minimum requirement (8).

[c] Body weight changes were converted to T.D.N., using 1 lb. gain equivalent to 3.53 lb. T.D.N. and 1 lb. loss equivalent to 2.73 lb. T.D.N (5).

[d] Efficiency of utilization of available T.D.N. determined using the following formula:

$$\frac{\text{T.D.N. requirement for maintenance and production}}{\text{T.D.N. available (consumed T.D.N.} + \text{T.D.N. equivalent of weight loss) or (consumed T.D.N.} - \text{T.D.N. equivalent of weight gain)}} \times 100 = \% \text{ efficiency of utilization of available T.D.N.}$$

[e] Average of two 35-d. periods.

tenance and production cannot be accounted for by weight gains or increased milk flow. Presumably, such energy has been dissipated in the production of body heat and in the energy required to eliminate that portion of the heat which must be removed to maintain proper body temperature. This loss of energy approximates Thorbek's (16) value of 30 per cent increased heat production resulting from the feeding of iodized casein.

Thomas (15) indicates no difference in caloric efficiency between control cows and thyroprotein-fed cows; but, he does show a greater efficiency when his figures are corrected for body weight gain and maintenance.

The studies of respiratory rates and heart rates assist in explaining the efficiency loss. During the warmest 5-wk. period, when the environmental temperature averaged 88° F. at the time rectal temperatures were taken, the thyro-

protein cows averaged 59 respirations per minute as compared to 42 for the two controls. The respiratory rates of the two groups showed little difference during the first and last periods when environmental temperatures averaged 70 and 76° F. During the warm middle experimental period, the thyroprotein-fed cows had a pulse rate of 97 compared to 75 for the cows receiving the basal ration. In the first period the heart rate of the experimental cows averaged 16 higher, but in the final period, when environmental temperatures were lower, there was very little difference.

Decreases in serum calcium and serum magnesium were noted during the middle of the summer for the four cows on the double reversal trial. The levels of both minerals again increased in September. This cannot be attributed to the thyroprotein feeding, but may indicate a seasonal variation. An

TABLE 2

Production response and efficiency of energy utilization in an 8-wk. continuous trial with thyroprotein fed to Holstein cows at rates of 1.33 and 2.00 g. per 100 lb. body weight

Cow no.	Ration	Total F.C.M. yield[a]	Yield change from preliminary period	Total T.D.N. requirement[b]	Total T.D.N. consumption	Weight change in T.D.N[c]	Efficiency of use of available T.D.N.[d]	
							Entire 8 wk.	Second 4 wk.
		(*lb.*)	(%)	(*lb.*)	(*lb.*)	(*lb.*)	(%)	(%)
878	Basal	2096	+ 4.2	1146	1275	+169	103.6	95.1
M53	Basal	862	−27.1	797	1066	+212	93.3	81.5
	Av.	1479	− 7.9	972	1171	+191	99.2	89.2
879	Thyro	1486	+22.6	923	1264	−238	61.5	59.5
986	at 1.33	2037	+17.2	1095	1234	− 96	82.3	95.4
M14	g./100#	2421	+ 2.5	1264	1509	−279	70.7	81.6
	Av.	1981	+11.9	1094	1336	−204	71.0	77.3
925	Thyro	2617	+19.9	1273	1414	−489	66.9	71.7
959	at 2.00	1781	+24.6	1026	1356	−268	63.2	64.6
M16	g./100#	2397	+23.9	1153	1499	−319	63.4	61.7
	Av.	2265	+22.5	1151	1423	−359	64.6	66.0

See table 1 for footnotes.

analysis of variance according to Snedecor (13) showed this mid-summer effect was statistically significant at the 1 per cent level of probability. Rusoff (10) observed no significant difference in his studies of seasonal effects upon blood levels of either mineral, although there was a significant monthly variation. Thyroprotein feeding increased blood sugar 4 to 31 per cent over the basal ration, while serum phosphorus apparently was not affected.

Continuous trial. In the second trial the two Holstein control cows during a period of 8 wk. dropped 7.9 per cent in F.C.M. below the preliminary period as shown in table 2. At the start of the trial, cow M53 was in her 22nd week of pregnancy, which accounts in part for her relatively rapid decline in yield. The three Holstein cows receiving 1.33 g. thyroprotein per 100 lb. body weight increased 11.9 per cent in F.C.M., while the three Holsteins receiving 2.00 g. thyroprotein per 100 lb. body weight produced 22.5 per cent more F.C.M. than

in the preliminary period. These production data indicate a greater lactation response from feeding the higher level of thyroprotein.

Body weight losses again were quite large for the cows receiving thyroprotein. The body weights reached their lowest point and stabilized after 5 wk. of thyroprotein feeding. The average loss at this time was 87 lb. for the three cows on the lower rate of thyroprotein feeding and 132 lb. on the higher rate. All cows were fed well above their calculated T.D.N. requirement, as table 2 shows. This surplus of T.D.N. amounted to 22 and 19 per cent for the lower and higher rates of thyroprotein addition.

The efficiency of utilization of the available T.D.N. was studied in the same manner as explained in the double reversal trial. Again, the cows on the basal ration were much more efficient in their use of T.D.N., and 99.2 per cent of their T.D.N. intake could be accounted for in live weight gain, production and maintenance. In the group of cows receiving 1.33 g. of thyroprotein per 100 lb. body weight, the efficiency of T.D.N. utilization was 71.0 per cent while the cows receiving the 2-g. level of thyroprotein showed only 64.6 per cent efficiency. Possibly at least some of the cows began to adjust for this augmented total thyroxin supply during the second 4 wk. of the trial. Four of the six cows which received thyroprotein showed relatively higher efficiency in T.D.N. utilization during the last half of the study than for the 8 wk. as a whole, as shown in table 2.

After the 8-wk. study was completed, two of the experimental cows, M14 and 925, were continued on their original level of thyroprotein feeding for a final 3-wk. period. These cows showed efficiencies of 105 and 112 per cent. Cows 879 and M16 were reduced one-half in rate of thyroprotein feeding for this final period and showed efficiencies of 70 and 91 per cent.

The last pair of thyroprotein cows, 986 and 959, were taken off thyroprotein and, as expected, they dropped rapidly in milk yield. They gained extremely rapidly in body weight, their total gains for the 21 days amounting to 79 lb. for 986 and 119 lb. for 959. The apparent efficiency of the body weight gains would indicate that cow 986 required only 1.75 lb. T.D.N. and cow 959 only 1.13 lb. T.D.N. for each pound of gain. Gains of this magnitude are very unusual, but were observed by Andrews and Bullard (1) following the partial thyroidectomy of steers. Thomas and Moore (14) have hypothesized that the thyroid gland may function at a subnormal rate for 140 or more days following the cessation of thyroprotein feeding. If this is true, partial thyroidectomy and removal of cows from thyroprotein feeding both produced temporary hypothyroid conditions with similar results. This suggests that decreased metabolic rate may have been partially responsible for the rate and efficiency of gain noted in these two cows following withdrawal of thyroprotein from their ration. Dairy cattle studies of the tissue changes accompanying the rapid weight losses and gains in thyroprotein feeding work are needed.

The respiratory rates for the three groups were similar in the preliminary period, but during the total 8-wk. experimental period, the controls averaged 45 respirations per minute while the cows fed at the rate of 1.33 and 2.00 g. thyro-

protein respired 67 and 77 times per minute, respectively, in counts made in mid-afternoon.

Body temperatures were identical for the three groups at the start. During the 8-wk. experimental period, the controls averaged 102.0° F., while the lower and the higher rates of thyroprotein treatment averaged 102.7 and 103.4° F., respectively. Body temperatures were no higher for hot, humid days than for hot, dry days. Extended periods of hot weather affected the body temperatures particularly. Average body temperatures when the environmental temperature was 96° F. were 102.3° F. for control cows, 105.0° F. for cows on the lower rate of thyroprotein feeding and 105.1° F. for the higher level.

Pulse rates showed the effect of the thyroprotein addition, averaging 81 for the controls, 83 for lower rate of treatment and 95 for the higher rate, although the groups were balanced in the experimental period. Blood pressure readings showed no particular differences between controls and experimental animals.

Blood studies of the serum calcium, serum inorganic phosphorus and the hemoglobin showed no differences attributable to thyroprotein feeding. Blood sugar showed increases over the preliminary period averaging 21 and 19 per cent for the lower and higher levels of thyroprotein, compared to 7.0 per cent for the controls. The cows getting 2.00 g. thyroprotein per 100 lb. body weight showed the highest blood sugar levels and averaged 65.7 g. blood sugar per 100 ml. of whole blood, compared to 47.1 mg. for these same cows in the preliminary period.

SUMMARY

Thyroprotein was fed in midsummer to four cows on a 15-wk. double reversal study at a rate of 1.5 g. per 100 lb. of body weight, and at levels of 1.33 g. and 2.0 g. to six cows on 8-wk. continuous study, using two controls.

1. F.C.M. production increases noted were 32 per cent on reversal and 12 and 22 per cent on continuous as compared to preliminary period with an 8 per cent loss for controls on the latter study.

2. Efficiencies of T.D.N. utilization, using formula table 1 were 69 per cent for thyroprotein feeding periods compared to 104 per cent on basal ration for reversal trial; and 71 and 69 per cent respectively for continuous study, with 99 per cent efficiency for control pair.

3. Several cows receiving thyroprotein improved in efficiency of T.D.N. utilization as the period of thyroprotein feeding proceeded. Rapid body weight losses occurred in both trials when thyroprotein was fed, even when additional T.D.N. was provided. When thyroprotein was withdrawn from the ration of two cows on continuous trial they suffered heavy losses in milk yield and made unusually rapid and efficient weight gains over a 21-day period during cooler weather. These rapid gains and losses raise questions concerning the type of tissue involved.

4. Accelerated respiratory rates and pulse rates, as well as increased body temperatures, offered partial explanation for the reduced efficiency of energy utilization by the thyroprotein-fed cows during this summer trial.

ACKNOWLEDGMENT

The authors wish to express their appreciation to R. P. Link of the University of Illinois College of Veterinary Medicine for his assistance in running part of the blood analyses and to K. E. Harshbarger for help in preparing the tables.

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MOTILITY OF SPERMATOZOA AND CONTROL OF BACTERIA IN BOVINE SEMEN EXTENDERS CONTAINING SULFANILAMIDE, POLYMYXIN AND AUREOMYCIN

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The importance of controlling bacterial growth in bovine semen used for artificial insemination or for fundamental metabolic studies has been pointed out by Salisbury *et al.* (16). It has been reported that the growth of many organisms commonly found in bovine semen can be inhibited by the addition of sulfonamides (6, 8, 12, 15), of penicillin (3, 7, 10), of streptomycin (2, 9, 15) and of penicillin plus streptomycin (1) without harmful effects on the motility of the spermatozoa. However, no data have been reported on the control of bacterial growth in semen by the recently discovered polymyxins or aureomycin.

The polymyxins A, B, C, D and E are bactericidal against Gram-negative bacteria. Long *et al.* (14) state that they are "definitely more effective than is streptomycin against susceptible bacteria". Stansly *et al.* (18) have shown that such organisms as *Escherichia coli, Aerobacter aerogenes* and *Pseudomonas aeruginosa,* which frequently are found in the semen of bulls, readily yield strains resistant to streptomycin, but under the same conditions do not yield strains resistant to polymyxin. Another antibiotic, aureomycin, has been found to be bacteriostatic to many Gram-positive and Gram-negative bacteria (4, 14), and it is the first antibiotic known to affect several large viruses (14). Lacy and Lankford (13) have found it to be more effective than streptomycin against 26 cultures of *Brucella.* In view of the reported high bactericidal action of polymyxin and aureomycin against a number of pathogens commonly found in semen and associated with breeding troubles, it seemed desirable to establish drug concentrations which would not impair the motility of the spermatozoa and to study bacterial growth at these levels.

MATERIALS AND METHODS

Three types of polymyxin, D, B and E, were used in these investigations. Polymyxin D has been described in detail by Stansly *et al.* (18) and B and E by Brownlee and Jones (5) and Jones (11). The hydrochloride form of aureomycin was used.

To make a simultaneous comparison of the effects of the antibiotics on the motility of spermatozoa and upon bacterial control, semen samples were divided into as many equal portions as there were levels of antibiotics chosen to be tested. Each portion of semen was mixed with 3.6 per cent citrate-yolk extender to which the antibiotics or sulfanilamide had been added. The average extension

Received for publication Feb. 17, 1950.

rate was 1 part of semen to 100 parts of extender. The extended semen then was stored at 5° C. in 3-ml. test tubes filled to capacity. Daily microscopic examinations of the extended semen afforded an estimate of the effects of the antibacterial agents on the motility of the spermatozoa. Statistical significance between means was tested by analysis of variance (17).

The number of living bacteria was determined by the plate count method. Beef infusion agar containing 0.25 per cent yeast extract and 0.05 per cent glucose was used to culture the bacteria. Control plates were made to check the sterility of the water used for dilutions, of the agar and of the atmosphere in the laboratory during the plating procedure. All plates were incubated at 37° C. for 96 hr. before counting.

TABLE 1

Motility of spermatozoa and numbers of bacteria in extended semen containing polymyxin D. (Av. of 7 ejaculates)

Duration of storage at 5° C. (*days*)	Control SA 300 mg.%	μg.[a] polymyxin/ml. of extended semen				
		0	500	1000	2500	5000
		Per cent of motile spermatozoa				
0	64	60	61	63	66	66
1	67	60	66	61	63	63
2	63	59	57	59	61	59
3	60	53	53	54	56	57
4	51	49	49	50	49	44
6	44	39	40	41	40	37
8	39	40	36	37	35	27
10	34	29	28	28	26	21
12	28	26	19	21	13	6
14	18	13	6	9	6	4
		1,000's of bacteria/ml.				
14	4.2	6,700	6.9	4.6	3.0	1.2

[a] The polymyxin sample was approximately 75% pure, so 0.75 × μg. used = equivalents of pure standard.

RESULTS

Polymyxin. In the first experiment, 11 semen samples were stored at 5° C. in citrate-yolk containing 0, 5, 25, 125 and 625 μg. of polymyxin D. Citrate-yolk containing 300 mg. per cent of sulfanilamide was used as the control. Microscopic examinations for 5 consecutive days indicated that none of these levels of polymyxin decreased the motility of the spermatozoa. In the second experiment, levels of 0, 500, 1000, 2500 and 5000 μg. of polymyxin D per ml. of extender were studied. Their effect upon the motility of spermatozoa and the control of bacteria in seven semen samples is shown in table 1. In all cases polymyxin D was effective in controlling bacterial growth. No immediate toxic effects on the spermatozoa were noted, but during the latter part of the storage period the per cent of motile spermatozoa surviving in the presence of high concentrations of polymyxin was considerably less than in the control.

Other experiments in this laboratory comparing polymyxin D, B and E indicated that these three polymyxins were similar in their effects on spermatozoan motility and bacterial growth. When added to the citrate-yolk extenders at levels as high as 2000 μg. per ml., all three were non-toxic to the spermatozoa, but were highly bactericidal. Brownlee and Jones (5) have reported that all polymyxins appear to have a similar bacterial spectrum.

Aureomycin. Aureomycin is unstable in alkaline solutions, but is stable for about 1 wk. at 5° C. in aqueous solutions of pH 2.5. Aureomycin added at the rate of 1000 μg. per ml. of citrate-yolk extender (pH 6.8) and stored for 15 hr. at 5° C. was just as effective against the bacteria present in 11 semen samples as was a freshly prepared solution of aureomycin of the same strength. However, this level of aureomycin was toxic to the spermatozoa. Likewise, 500 μg. of aureomycin per ml. of extender were found to be both bactericidal and spermicidal. In an effort to establish levels of aureomycin which would not be harmful

TABLE 2

The effect of aureomycin on motility of spermatozoa and bacterial growth (Av. of 10 ejaculates)

Duration of storage at 5° C. (*days*)	Control SA 300 mg.%	μg. of aureomycin/ml. of extender			
		0	100	200	500
	Per cent of motile spermatozoa				
0	71	69	69	68	68
1	66	69	67	67	64
2	61	62	61	57	52
4	54	52	50	39	31
	1000's of bacteria per ml. after 24 hr. at 5° C.				
1	0.19	3.4	0.36	0.21	0.22
	1000's of bacteria per ml. after 24 hr. at 20° C.				
1[a]	5.9	430.	7.3	6.5	6.3

[a] At 20° C.

to the spermatozoa, aureomycin was added at the rate of 0, 100, 200 and 500 μg. per ml. of the citrate-yolk extender. The citrate-yolk extender containing 300 mg. per cent of sulfanilamide was used as the control. Each of 20 semen samples was divided into five equal parts and each part added to one of the extenders being tested. The first ten samples were stored at 5° C. To provide an opportunity for greater bacterial growth, the next ten samples were stored at 20° C. Platings were made on all samples after 24 hr. of storage since most semen is used for insemination after approximately 24 hr. of storage. The per cent of motile spermatozoa was estimated microscopically in the samples stored at 5° C. The results are in table 2. After 1 day of storage the levels of 200 and 500 μg. of aureomycin per ml. of extended semen were harmful to the spermatozoa ($P < 0.05$). All levels of aureomycin tested and the sulfanilamide control effectively reduced bacterial growth at 5 and at 20° C., as compared to the

growth when no antibacterial agent was added. Therefore, aureomycin may be used to inhibit bacterial growth in extended semen, but to avoid spermicidal effects the dosage should not exceed 100 μg. per ml. of extended semen.

SUMMARY

The effect of polymyxins D, B and E and aureomycin on the motility of bovine spermatozoa and upon the control of bacterial growth in bovine semen extended with citrate buffered yolk and stored at 5° C. was investigated. It was found that 2000 μg. of polymyxins D, B or E, or 100 μg. of aureomycin could be added per ml. of extender without spermicidal effects. These levels of antiobiotics were highly bacteriostatic and/or bactericidal.

ACKNOWLEDGMENTS

For the supply of antibiotics used in these investigations the authors are indebted to H. J. White, Stamford Research Laboratories, American Cyanamid Co. for the polymyxin D, to D. S. Searle, Burroughs Wellcome and Co. for the "Aerosporin" brand of polymyxin B, to H. A. Nash, Pitman-Moore Co. for the polymyxin E and to C. R. Schroeder, Lederle Laboratories Division, American Cyanamid Co. for the aureomycin.

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THE FERTILITY OF BOVINE SEMEN IN EXTENDERS CONTAINING SULFANILAMIDE, PENICILLIN, STREPTOMYCIN AND POLYMYXIN

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The effect of sulfanilamide, penicillin and streptomycin, singly and in combinations, on the fertility of bovine semen is controversial. Almquist (3) has reported no significant improvement in fertility when semen from high fertility bulls was treated with penicillin. On the other hand, Almquist (1, 2) has reported large increases in fertility accompanying the addition of penicillin, streptomycin, and penicillin plus streptomycin to semen from low fertility (problem) bulls, but no increase accompanying the use of sulfanilamide alone. Mixner (9) observed that when sulfanilamide or sulfanilamide plus penicillin was added to the extended semen of highly fertile bulls, the average fertility level was 7 percentage units higher than when penicillin alone was added. However, this difference was not significant statistically. Since the experiments to be reported herein were completed, Mixner (10) has reported that the addition of streptomycin or streptomycin plus penicillin to citrate-sulfanilamide-yolk extender did not increase the fertility of bovine semen. In contrast, Easterbrooks *et al.* (5) recently have reported a significant average increase in fertility accompanying the addition of streptomycin to the extended semen of bulls in general. The studies reported in this paper were conducted to obtain more information on the possible value of penicillin, streptomycin, polymyxin and sulfanilamide for improving the fertility of bulls with histories of relatively low fertility as well as bulls with histories of high fertility, when their semen was extended in citrate-yolk containing non-spermicidal quantities of these antibacterial agents.

EXPERIMENTAL PROCEDURE

Two groups of nine bulls each were selected from the active stud of the New York Artificial Breeders' Cooperative, Inc. One group was comprised of bulls with histories of high fertility, while the other group was comprised of bulls of somewhat lower average fertility. On the basis of the 60- to 90-day non-returns to first service cows, the high fertility bulls averaged 64 per cent and the low fertility bulls 54 per cent during the 8 mo. preceding the experiment.

Sixty-four semen samples initially containing 500×10^6 or more spermatozoa per ml. of which 50 per cent or more were estimated to be motile were used for insemination. All samples were partially extended immediately after collection at a rate of approximately 1:4 with warm (98° F.) 3.6 per cent citrate-yolk extender (7) and cooled to 5° C. in 75 min. After cooling they were divided into six portions and each portion extended to its final volume using the cold (5° C.) extenders composed of equal parts of fresh egg yolk and one of the six

Received for publication Feb. 17, 1950.

buffers shown in table 1. The levels of antibiotics used were based on the reports by Foote (6) and Foote and Bratton (8). Final extension rates were adjusted to give approximately 15×10^6 motile spermatozoa per ml. of extended semen. All extenders were prepared during the afternoon of the day previous to their use and were stored at 5° C. in the dark until used.

Inseminations were made by the regularly employed technicians associated with the New York Artificial Breeders' Cooperative, Inc. Semen from each bull was shipped a sufficient number of times to allow all technicians equal opportunities for using each bull and each extender.

Fertility was measured by the per cent of first and second service cows not returning to artificial service within 60- to 90-days after the month in which they were bred. The per cent non-returns calculated for each semen sample × treatment (experimental extender) sub-class was used as the experimental unit in the analysis of variance (13).

TABLE 1

Composition of experimental buffers

Ingredients	Buffers					
	1	2	3	4	5	6
Sodium citrate dihydrate, *g.*	3.6	3.6	3.6	3.6	3.6	3.6
Sulfanilamide, *g.*	.....	0.6	.....	.....	.....	0.6
Penicillin G sodium crystalline (Merck), Oxford units	.....	.....	100,000	.....	.....	100,000
Streptomycin, calcium chloride complex (Merck), μ*g.*	.....	.....	.....	100,000	.....	100,000
Polymyxin sulfate, μ*g.*	.....	.....	.....	.....	100,000	100,000
H_2O, distilled over glass to vol., *ml.*	100	100	100	100	100	100

RESULTS AND DISCUSSION

The number of first and second service cows inseminated and the mean percentages for the 60- to 90-day non-returns for these cows are shown in table 2. The analysis of variance of the per cent non-returns to first service cows revealed a significant treatment × fertility group interaction ($P < 0.05$). The treatment means for the per cent non-returns were not significantly different for the high fertility group of bulls. On the other hand, the addition of penicillin, streptomycin or the combination of all antibacterial agents to the extended semen of the low fertility group of bulls was accompanied by non-return rates that averaged approximately 10 percentage units higher than those accompanying the use of sulfanilamide, polymyxin or no antibacterial agent. On the basis of the combined first and second service cows for botb high and low fertility groups of bulls the *F* value for the differences between the means for extenders was slightly less than that required for significance at the 5 per cent level of probability.

In this experiment there was only a small difference between the non-return percentages for the 3.6 per cent citrate-yolk and 3.6 per cent citrate-sulfanilamide-

yolk. This difference is in contrast to results previously reported from this laboratory (4, 11, 12). However, it is in agreement with more recent unpublished findings in this laboratory (14), which suggest that the cooling procedure (7) accompanying the processing of semen may accomplish an increase in fertility similar to that attributed to sulfanilamide (4, 12).

The results obtained in these studies, together with those obtained by Almquist (1, 2) and Easterbrooks *et al.* (5), appear to warrant the use of penicillin, streptomycin or a combination of these plus polymyxin and sulfanilamide in extenders for bovine semen for the purpose of increasing, to a limited extent, the over-all fertility level of bovine semen used for artificial breeding.

TABLE 2

Average fertility of extended semen containing sulfanilamide, penicillin, streptomycin, polymyxin and combinations of these antibacterial agents based on 60- to 90-day per cent non-returns to first and second service cows

Cow group	Bull fertility group		Extenders					
			No antibiotic	Sulfanilamide	Penicillin	Streptomycin	Polymyxin	All combined
1st service cows	High	No. serv.	334	341	336	352	356	326
		% N.R.[a]	65	66	71	69	67	68
	Low	No. serv.	334	309	281	292	245	277
		% N.R.	58	61	68	69	61	73
	Combined	No. serv.	668	650	617	644	601	603
		% N.R.	62	64	69	69	64	71
1st and 2nd service cows	High	No. serv.	472	506	472	488	499	452
		% N.R.	63	64	70	69	68	67
	Low	No. serv.	461	421	413	419	363	393
		% N.R.	58	60	67	66	59	69
	Combined	No. serv.	933	927	885	907	862	845
		% N.R.	61	62	68	68	64	68

[a] N.R. = non-returns.

SUMMARY

By use of the split sample technique the fertility of bovine semen extended in 3.6 per cent citrate-yolk containing no antibacterial agent, sulfanilamide, penicillin, streptomycin, polymyxin or a combination of these four antibacterial agents was studied. Semen was used from bulls with histories of low fertility, as well as from bulls with histories of high fertility.

The per cent 60- to 90-day non-returns to first and second service cows for the treatments, no antibacterial agent, sulfanilamide, penicillin, streptomycin, polymyxin, and sulfanilamide plus penicillin plus streptomycin plus polymyxin were, respectively, for the high fertility bulls, 63, 64, 70, 69, 68, and 67; for the low fertility bulls, 58, 60, 67, 66, 59, and 69 and for both the high fertility and the low fertility bulls combined, 61, 62, 68, 68, 64, and 68. On the bases of these results and those reported by other workers, it is concluded that the addition of penicillin, streptomycin or a combination of these plus polymyxin and sulfanila-

mide to present day extenders may be expected to increase the over-all fertility level of bovine semen used for artificial breeding.

ACKNOWLEDGMENTS

The authors gratefully acknowledge the assistance and cooperation of the management of and the technicians associated with the New York Artificial Breeders' Cooperative, Inc., in furnishing the semen samples and in performing the inseminations, and the cooperation of D. S. Searle, Burroughs Wellcome and Co. in furnishing the "Aerosporin" brand of polymyxin B.

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CARBOHYDRATE UTILIZATION IN THE YOUNG CALF. I. NUTRITIVE VALUE OF GLUCOSE, CORN SYRUP AND LACTOSE AS CARBOHYDRATE SOURCES IN SYNTHETIC MILK[1]

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The problem of a satisfactory milk replacement for the raising of calves is a matter of utmost economic importance to the dairyman. Many calf starters have been developed but, in general, success appears to depend upon the use of at least 300 lb. of whole milk and the inclusion of dried milk products in the starter (7, 11, 13, 24, 25). Synthetic milks in themselves are far from being the answer to the economic problem in that the cost of purified components is much greater than the cost of whole milk. Yet fundamental problems can be approached through this means which can not be studied with calves on natural feeds. Early attempts to raise calves on purified diets were unsuccessful (8) but Wiese *et al.* (23) have reported the formulation of a synthetic diet satisfactory for the nutrition of the young calf.

In this investigation an attempt was made to determine the relative efficiency of certain carbohydrates incorporated in synthetic milks for calves. Since Wiese *et al.* (23) were successful with glucose, this sugar was selected for use as the control. Lactose, the natural carbohydrate source of the neonatal mammal, and Karo corn syrup, frequently used in formulas for infants, were selected for comparison with glucose.

EXPERIMENTAL PROCEDURE

Selection of animals. The composition of the three experimental groups is indicated in table 1. All of the 18 experimental calves were males, with the exception of one female in group *G*. The system used in assigning calves to the groups and subgroups consisted of random allotment as the calves were born in the College experimental herd. The only prerequisite to assignment was normal health and appearance. Calves were placed on experiment 2 to 3 days after birth and retained for a 31-day feeding trial, since the first month is the critical period with respect to carbohydrate utilization in the calf (19). Following the feeding trial, autopsy was performed on most of the animals, al-

Received for publication March 16, 1950.

[1] Published with the approval of the Director of the Michigan Agricultural Experiment Station as Journal Article no. 1134.

[2] This article is part of a dissertation presented to the Faculty of the Graduate School of Michigan State College in partial fulfillment of the requirements for the degree of Doctor of Philosophy.

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though a few were returned to the College experimental herd for subsequent research.

Feeding and management. Of necessity, calves were started on the experiment in all seasons of the year. Possible differences due to prenatal nutrition were minimized, since the dams were stall-fed throughout the year. Calves were permitted to remain with their dams for 12 hr. following parturition. Subsequently, each calf was placed in an individual pen, starved 14 to 24 hr.

TABLE 1

Composition of the experimental groups

Group	Sub-group	No. of calves	Breed Distribution	Av. starting wt.
				(*lb.*)
G (glucose)	.....	6	5 Holstein, 1 Ayrshire	94.3
	10	2	1 Jersey, 1 Brown Swiss	82.0
K (corn syrup)	30	2	2 Holstein	96.5
	45	2	1 Jersey, 1 Brown Swiss	75.5
	5	2	1 Holstein, 1 Jersey	67.0
L (lactose)	10	2	2 Holstein	81.5
	30	2	1 Holstein, 1 Jersey	69.5

and started on the synthetic milk diet. Feed was given twice daily via nipple pail at a rate calculated to meet the recommended nutrient allowances of the National Research Council (9).

The constituents of each of the rations fed are listed in table 2, and the chemical analyses of these rations are presented in table 3. In addition to the

TABLE 2

Ingredients of the rations fed

Group	Ration						
	G	K			L		
Subgroup		10	30	45	5	10	30
Glucose	60	50	30	15	55	50	30
Corn syrup	.....	10	30	45	.....	.....	.....
Lactose	.....	.....	.....	.....	5	10	30
Casein	25	25	25	25	25	25	25
Lard	10	10	10	10	10	10	10
Salts[a]	5	5	5	5	5	5	5

[a] The salt mixture was composed of 10 parts $CaCO_3$, 20 parts $CaHPO_4 \cdot 2H_2O$, 20 parts $Mg_3(PO_4)_2 \cdot 4H_2O$, 10 parts K_2HPO_4, 5 parts NaCl, 5 parts KCl, 1.98 parts $FeC_6H_5O_7 \cdot XH_2O$, 0.04 parts $MnSO_4 \cdot 4H_2O$, 0.04 parts $CuSO_4 \cdot 5H_2O$ and 0.04 parts $CoSO_4 \cdot 4H_2O$.

components listed, each calf received (a) a capsule containing 70,000 I.U. of vitamin A (shark liver oil) and 10,000 I.U. of vitamin D (viosterol) at the time it was placed on experiment and at weekly intervals thereafter and (b) a daily dosage of 20 mg. thiamin hydrochloride, 20 mg. riboflavin, 20 mg. calcium pantothenate, 20 mg. nicotinic acid, 20 mg. para-aminobenzoic acid, 5 mg. pyridoxine hydrochloride, 10 mg. vitamin K, 1 mg. biotin, 200 mg. inositol and 3 g. choline chloride. These water soluble vitamins were prepared in stock solu-

tion, stored in amber glass under refrigeration and added to the synthetic milk at the time of the morning feeding.

The carbohydrate content of the rations was varied in the different groups. In the *G* group, which was used as the control, glucose was the carbohydrate source; various amounts of glucose were replaced with corn syrup in the *K* group and various amounts of glucose were replaced with lactose in the *L* group, as shown in table 2.

Calf pens were bedded with wood shavings. No hay was fed, and in order to minimize consumption of shavings, each calf received daily 1 oz. of a mixture containing 10 per cent cellulose, 57 per cent glucose, 24 per cent casein, 5 per cent salts and 4 per cent diluted corn syrup. With few exceptions calves ate this dry mix readily and showed slight inclination to consume shavings.

Preparation of feed. The synthetic milk was prepared by a modification of

TABLE 3

Chemical analysis of the rations fed

Group	Ration						
	G	K			L		
Subgroup		10	30	45	5	10	30
Moisture (%)	7.22	8.51	11.02	13.06	6.95	6.68	5.62
Protein (%)	21.39	21.36	21.30	21.26	21.38	21.38	21.37
Ash (%)	5.64	5.73	5.92	6.06	5.64	5.64	5.65
Crude fiber (%)	0.11	0.10	0.08	0.06	0.11	0.10	0.08
Ether ext. (%)	10.34	10.31	10.21	10.15	10.34	10.34	10.34
N. F. E. (%)	55.30	53.99	51.47	49.41	55.58	55.86	56.94
Ca (%)	0.65	0.65	0.66	0.67	0.65	0.65	0.65
P (%)	0.77	0.77	0.78	0.78	0.77	0.77	0.77
Mg (%)	0.31	0.32	0.35	0.37	0.31	0.32	0.32
K (%)	0.52	0.55	0.61	0.65	0.52	0.52	0.52
Fe (%)	0.0014	0.0016	0.0020	0.0023	0.0014	0.0014	0.0014
Cu (*ppm.*)	2.1	2.1	3.9	4.8	2.2	2.2	2.4
Mn (*ppm.*)	0.07	0.07	0.07	0.07	0.07	0.07	0.07
Co (*ppm.*)	0.115	0.117	0.121	0.124	0.116	0.118	0.124

the procedure of Wiese *et al.* (23). Due to the limited refrigeration facilities available at the experimental barn, the synthetic milk was prepared once or twice weekly and stored as a liquid concentrate. The frequency of preparation depended upon the number of calves on trial at any particular time. The liquid concentrate was prepared as follows: Four ounces of sodium bicarbonate were dissolved in 43 lb. of water at 60° C. A heavy-duty electric stirrer was used and 5 lb. of casein were added slowly with constant agitation. Stirring was continued 20 to 30 min. to insure complete solution of the casein. Near the end of the agitation period 2 lb. of lard (80° C.) were thoroughly mixed with the casein solution. The casein-lard solution was homogenized at 3,000 lb. pressure. The remaining components of the ration (carbohydrate(s) and salts, table 2) were mixed dry and 12.5 lb. of this dry mix were blended with the 50 lb. of the homogenized solution. The synthetic milk liquid concentrate thus prepared contained 33.3 per cent dry matter and was stored under re-

frigeration in this form. At feeding time one part of the concentrate was added to two parts of hot water, the vitamin solution added (mornings only) and the product fed at 85 to 95° F.

Criteria for evaluation of response. Evaluation of the response to the experimental rations was based upon (a) observations on the health and general appearance, (b) growth and efficiency of feed utilization, (c) blood analyses, (d) rumen population and (e) post-mortem examinations.

(a) *Health and general appearance.* Observations and recordings were made at least once daily with regard to general condition, appetite and general reactions of the animals and the consistency of the feces.

(b) *Growth and efficiency of feed utilization.* An accurate tabulation of feed consumption and refusal was maintained. Each calf was weighed prior to the morning feeding on the day it was placed on the experiment and on the 4th, 7th, 11th, 14th, 18th, 21st, 25th, 28th and 31st days of the trial.

(c) *Blood analyses.* Blood samples were collected from the jugular vein of each calf at weekly intervals. Determinations of hemoglobin and hematocrit were made on whole blood by the methods of Sanford *et al.* (18) and Wintrobe (26), respectively. The plasma was analyzed for calcium, inorganic phosphorus, magnesium (5) and ascorbic acid (10).

(d) *Rumen population.* Samples of the rumen contents were obtained from most of the calves at weekly intervals. A few calves objected to the passage of the stomach tube and no attempt was made to force collection from such calves. The collections were made 4 hr. after the morning feeding. The samples were preserved in an aqueous solution of formaldehyde and counts were made of iodophilic organisms (1) and total bacteria (21) per milliliter of rumen contents.

(e) *Post-mortem examinations.* Animals which died during the trial or were killed at the end of the experimental period were subjected to gross postmortem examinations. Histological sections were made of selected organs from representative animals and of any organ or tissue which appeared abnormal in the gross inspection.

RESULTS

Health and general appearance. Within 2 to 4 days after being placed on the experiment, feces from calves of the *G* (glucose) and *K* (corn syrup) groups invariably would become quite soft and in many cases semiliquid. The *K* group was much more severely afflicted than was the *G* group. On the other hand, *L* (lactose) calves, even at the 5 per cent level, maintained normal consistency of feces throughout the trial. The *L* calves, in general, possessed smoother hair coats and showed more alertness than animals in the other groups. Calves on corn syrup, though their weight gains compared favorably with those of calves on glucose, characteristically had much duller hair coats than the latter. All calves drank the synthetic milk readily. Bloat occurred in two glucose calves, and one calf receiving the 10 per cent level of lactose died of acute bloat of the abomasum.

Growth and feed utilization. The gain in body weight and the efficiency of feed utilization of each of the experimental groups and subgroups is indicated in table 4. In view of the extensive variation in the starting weight, gains are represented both as pounds and as percentage increase over the starting weight.

Blood analysis. The average values for hematocrit, hemoglobin and plasma calcium, inorganic phosphorus, magnesium and ascorbic acid for each group are presented graphically in figure 1. These values appear to be within the normal range for calves of this age (2, 28). There is little apparent difference between groups in any of the constituents, although the plasma ascorbic acid tends to be slightly lower in the corn syrup-fed calves than in the other groups.

Rumen population. A total of 38 rumen samples were collected from the three groups. The average iodophil counts (millions per ml.) were 423.0, 463.1 and 215.9, while the average total counts (millions per ml.) were 2,800, 4,222 and 2,400 for the *G*, *K* and *L* groups, respectively. However, the variations

TABLE 4

Growth and feed utilization

Group	Sub-group	Average gain		Gain/lb. DM consumed
		(*lb.*)	(%)	(*lb.*)
G	Av.	9.33 ± 1.58[a]	8.13	0.234 ± 0.055
K	10	15.50	18.90	0.240
	30	14.50	15.03	0.231
	45	−4.00	−5.30	−0.044
	Av.	8.66 ± 5.68	10.23	0.142 ± 0.092
L	5	16.00	23.88	0.306
	10	20.50	25.15	0.508
	30	19.50	28.06	0.338
	Av.	18.66 ± 2.73	25.92	0.384 ± 0.050

[a] Standard error of the mean.

obtained between calves within groups and between samples from the same calf on different dates were so great that no significance can be attached to the means.

Post-mortem examination. Ten of the 18 experimental calves were subjected to post-mortem examination, either during the experimental period or at the completion of the trial, with the exception of one calf which was examined 10 days after completion of the trial. Two lactose calves and four from each of the remaining groups were autopsied during this period. Congestion and consolidation of lung tissue was the most common finding, although focal interstitial nephritis (white spotted kidney) also was prevalent. Focal interstitial nephritis occurred irrespective of the dietary regime. Congestion and consolidation of lung tissue occurred with equal frequency in the glucose and corn syrup groups, but during the experimental period only one of the lactose calves had a "cold," which was successfully treated with sulfathiazole. Ulceration of the pylorus, petechial hemorrhages of the abomasum and patchy congestion of the intestinal tract occurred frequently in the corn syrup and glucose groups,

but less frequently and less severely in the lactose group. The previously mentioned lethal bloat in one lactose calf resulted in rupture of the abomasal wall.

DISCUSSION

Although growth responses were satisfactory in at least one of the groups, the reaction of calves to the synthetic milk hardly can be considered normal. The high incidence of respiratory disturbances, as evidenced by visible symp-

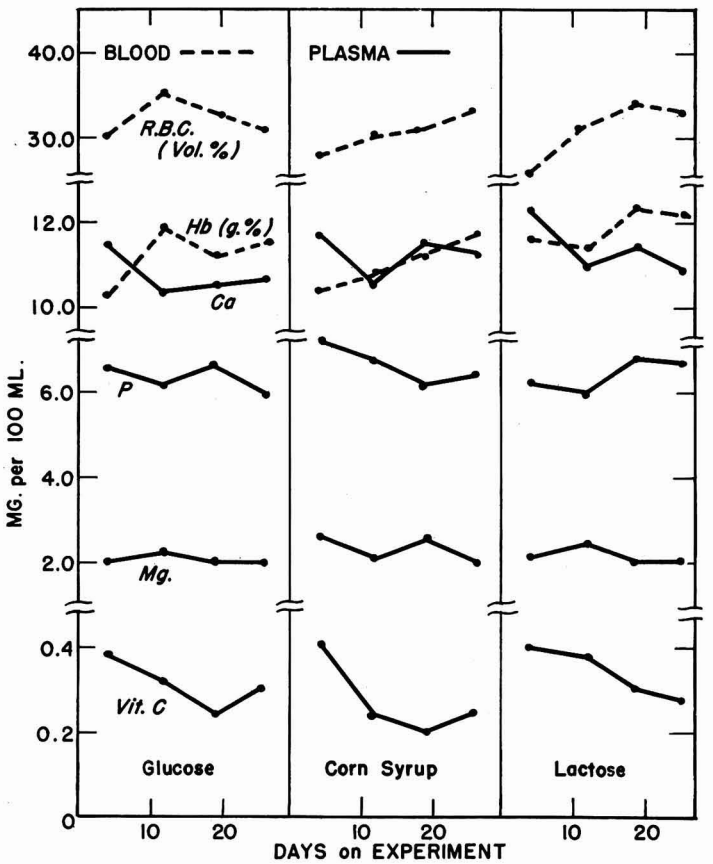

FIG. 1. Changes in the composition of the blood of calves.

toms as well as post-mortem findings, indicates that the ability of the calves to resist infection was low; however, the physical condition of the calves in the lactose group was superior to the calves in the other groups. The incidence of focal interstitial nephritis also was high, but the etiology of this condition is vague. Moore and Hallman (12) found it associated with low vitamin A in-

take in young calves, while Smith (20) reported the deprivation of colostrum as a predisposing factor.

The blood data indicate that sufficient calcium, phosphorus and magnesium were absorbed to maintain the levels of these elements in the plasma. The reported rise in plasma inorganic phosphorus during the first 3 wk. of life (15, 28) was not apparent in these experimental animals. Likewise, the normal decline in hemoglobin concentration and in hematocrit (28) was not evident in these trials. Such a decline possibly was prevented by the inclusion of iron and trace elements in the synthetic milk, although Davidson and Leitch (4) report other than the reduction in hemoglobin and hematocrit following birth is independent of iron reserves and of dietary intake. This does not preclude the possibility that one or more of the trace elements included in the ration may have prevented the decline.

Corn syrup, a food substance widely used in formulas for infants, was selected as a promising carbohydrate for the neonatal calf. The results refuted pre-experimental expectations. Although growth at the 10 and 30 per cent levels compared favorably with other groups, the feces were of foul odor and of semiliquid consistency. Apparently, the laxation produced by corn syrup offset any beneficial nutritive value it may have possessed. Chemical analyses (table 3) indicated that corn syrup was high in ash. It is possible that this ash contained some element(s) which caused the laxation and thus prevented the animals from utilizing properly the feed consumed.

The beneficial effect of lactose on the intestinal tract, as evidenced by the consistency of feces, was striking, and results of this benefit are reflected in the growth response and in the efficiency of feed utilization. Much of the beneficial action of lactose may be credited to its stability and low solubility which permits it to pass unchanged into the intestine. In the intestine it promotes the growth of beneficial lactic acid-producing bacteria and inhibits scatologic putrefaction (3, 14). Although this view is not universally accepted (16, 22), it has much in its favor and must be considered until a more satisfactory explanation is advanced.

Rumen bacterial samples were collected for study as a possible index to the time at which the rumen commences to function, but these samples revealed little difference among the groups. However, the intestinal flora are probably of much greater importance in controlling gastro-intestinal motility than are those of the rumen. A recent review (6) adequately discusses the effect of lactose on gastro-intestinal motility and indicates that there is more evidence supporting the contention that lactose tends to cause diarrhea than there is evidence to the contrary. Within the bovine species, Wise (27) has used dried whey in treating chronic diarrhea in calves and Rojas *et al.* (17) have indicated that under normal feeding conditions lactose was utilized effectively by calves. It was only when the lactose content of milk was doubled that diarrhea and unthriftiness occurred and the efficiency of utilization was decreased markedly. The results of feeding lactose in synthetic milk are in harmony with the report of Rojas *et al.*, since in all cases the lactose content of synthetic milk was below the level contained in normal cow's milk.

Whatever the mode of action of lactose, the quantity required by the calf is small, because 5 per cent produced almost as satisfactory growth response as did 30 per cent. Although the difference was small, the greatest efficiency of feed utilization was obtained at the 10 per cent level of lactose. Whether the decrease in efficiency at the 30 per cent as compared to the 10 per cent level is due to too high a proportion of lactose or to biological variation is open to speculation.

SUMMARY

Eighteen neonatal calves were allotted to three experimental groups and fed rations consisting of synthetic milks which varied only in the source of carbohydrate.

The average gain in weight for the 31-day experimental period was 9.33 lb. for glucose-fed calves (*G*), 8.66 lb. for corn syrup-fed calves (*K*) and 18.66 lb. for lactose-fed calves (*L*). The efficiency of feed utilization, expressed as the average of gain per pound of dry matter consumed, was 0.234, 0.142 and 0.384 for the *G*, *K* and *L* groups, respectively. Within the subgroups, 10 and 30 per cent corn syrup produced fair results, while 45 per cent was unsatisfactory. There was little difference in weight gains in response to lactose at the 5, 10 and 30 per cent levels.

Analysis of blood at weekly intervals for hematocrit, hemoglobin and plasma calcium, inorganic phosphorus, magnesium and ascorbic acid showed no apparent departure from the normal.

Examination of rumen samples for microorganisms revealed that individual differences were greater than differences between groups.

On post-mortem examination, pneumonia, patchy congestion of the intestinal tract, abomasal petechial hemorrhages and ulceration about the pylorus were observed less frequently in the *L* than in *G* and *K* groups, while focal interstitial nephritis occurred indiscriminately in all groups.

The authors wish to thank Sheffield Farms Co., Inc., New York, N. Y., for supplying most of the lactose used in this study. The authors are grateful to E. J. Benne for the chemical analyses of feed samples and to G. M. Trout for the use of the homogenizer.

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CARBOHYDRATE UTILIZATION IN THE YOUNG CALF. II. THE NUTRITIVE VALUE OF STARCH AND THE EFFECT OF LACTOSE ON THE NUTRITIVE VALUES OF STARCH AND CORN SYRUP IN SYNTHETIC MILK[1]

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Lactose has been shown to benefit the calf when it replaced glucose in synthetic rations in amounts as small as 5 per cent of the ration (5). Under practical feeding conditions the bulk of the carbohydrate in a calf starter consists of starch. The report of Shaw *et al.* (15) indicates that the calf is unable to digest starch efficiently until 4 to 5 wk. of age.

The investigation reported herein was undertaken to determine the effect of lactose on the utilization of such carbohydrate sources as starch and corn syrup in synthetic rations by the very young calf.

EXPERIMENTAL PROCEDURE

Neonatal calves were randomized to the three experimental groups listed in table 1. As in the previous investigation (5), calves were started on the ex-

TABLE 1

Composition of the experimental groups

Group	No. of calves	Breed distribution	Av. starting wt.
			(*lb.*)
KL (Corn syrup + lactose)	3	2 Holstein 1 Jersey	69.0
SL (Starch + lactose)	3	1 Holstein 1 Ayrshire 1 Jersey	77.0
S (Starch)	3	3 Holstein	95.0

periment as they were born in the College experimental herd. Details regarding the selection, feeding and management of animals and the preparation of feed have been described previously (5). The present study was initiated near the

Received for publication March 16, 1950.

[1] Published with the approval of the Director of the Michigan Agricultural Experiment Station as Journal Article no. 1135.

[2] This article is part of a dissertation presented to the Faculty of the Graduate School of Michigan State College in partial fulfillment of the requirements for the degree of Doctor of Philosophy.

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close of the aforementioned investigation and, in regard to methods, was merely a continuation of it. Various amounts of carbohydrates were incorporated in the rations, as shown in table 2. The *KL* group received glucose, corn syrup and lactose as the carbohydrate sources, the *SL* group received glucose, lactose

TABLE 2

Ingredients of the rations fed

Group	Ration		
	KL	SL	S
Glucose	5	5	15
Corn syrup	45	.....	.....
Lactose	10	10	.....
Starch	.....	45	45
Casein	25	25	25
Lard	10	10	10
Salts[a]	5	5	5

[a] The salt mixture was composed of 10 parts $CaCO_3$, 20 parts $CaHPO_4 \cdot 2H_2O$, 20 parts $Mg_3(PO_4)_2 \cdot 4H_2O$, 10 parts K_2HPO_4, 5 parts NaCl, 5 parts KCl, 1.98 parts $FeC_6H_5O_7 \cdot XH_2O$, 0.04 parts $MnSO_4 \cdot 4H_2O$, 0.04 parts $CuSO_4 \cdot 5H_2O$ and 0.04 parts $CoSO_4 \cdot 4H_2O$.

and starch, and the *S* group received glucose and starch. Composition and the chemical analyses of the rations fed are presented in tables 2 and 3, respectively.

Criteria for the evaluation of response were altered from those of the previous investigation in that no samples of rumen contents were collected and only one post-mortem examination was conducted. The single autopsy was performed on a member of the *S* group to check for lesions previously produced on a starch-containing synthetic milk (4).

TABLE 3

Chemical analysis of the rations fed

Group	Ration		
	KL	SL	S
Moisture (%)	12.52	7.36	7.90
Protein (%)	21.25	21.57	21.57
Ash (%)	6.06	5.63	5.62
Crude fiber (%)	0.05	0.07	0.08
Ether ext. (%)	10.15	10.61	10.61
N. F. E. (%)	49.97	54.76	54.22
Ca (%)	0.67	0.65	0.65
P (%)	0.78	0.78	0.78
Mg (%)	0.38	0.34	0.33
K (%)	0.65	0.52	0.52
Fe (%)	0.0023	0.0022	0.0021
Cu (*ppm.*)	4.9	2.2	2.1
Mn (*ppm.*)	0.07	0.07	0.07
Co (*ppm.*)	0.127	0.118	0.115

In search of a possible explanation for varying responses to the carbohydrates fed, a test meal containing a single carbohydrate source (*e.g.*, glucose, lactose, starch or corn syrup) was fed to an animal, and the blood sugar concentration determined at intervals over an 8-hr postprandial period. The

test was repeated until a curve for each carbohydrate was obtained on three different calves. The test meal consisted of 25 per cent casein, 10 per cent lard, 5 per cent salts and 60 per cent of the carbohydrate being tested. Carbohydrates were calculated on the dry-matter basis to eliminate differences in carbohydrate intake caused by variable moisture content. This meal was prepared in the same manner as the usual experimental ration and fed according to the recommended allowances of the National Research Council (7). Interpolations of these recommended allowances were made to adjust feed intake to requirements based on the exact body weights of the calves. On the day of the test, blood was collected prior to the morning feeding. The test meal was fed and subsequent blood samples were taken at 0.25, 0.5, 1, 2, 4, 6 and 8 hr. postprandially. All blood samples were collected by jugular venipuncture with minimum disturbance to the animal. To facilitate rapid, efficient collection of blood, the neck was clipped closely a day or two prior to collection.

Potassium oxalate was used as the anticoagulant. Filtrates were prepared within 30 min. after the collection of blood and the amount of blood sugar was determined by the Somogyi procedure (16). Transmission was determined by a Cenco-Sheard spectrophotometer at 520 mμ.

TABLE 4

Growth and feed utilization

Group	Average gain		Gain/lb. DM consumed
	(*lb.*)	(%)	(*lb.*)
KL	28.33 ± 5.85[a]	41.06	0.487 ± 0.058
SL	24.67 ± 2.94	32.03	0.412 ± 0.072
S	14.00 ± 3.06	14.74	0.204 ± 0.046

[a] Standard error of the mean.

RESULTS

Health and general appearance. The feces of calves in group *S* became very soft in consistency within 2 to 4 days after the animals were placed on experiment. The amount of feces voided was quite large, and the feces appeared to contain considerable undigested material. Calves of the *SL* group also voided excessive quantities of feces of semiliquid consistency, although, in general, the diarrhea in this group was not so severe as that in the *S* group. Diarrhea occurred infrequently in the *KL* group, in marked contrast to group *K* of the previous trial (5). Calves of the *S* group showed moderate emaciation and dehydration during the first 2 wk. of the trial, whereas those of groups *SL* and *KL* were relatively thrifty throughout the trial.

Growth and feed utilization. Gains in body weight for the 31-day period and the efficiency of feed utilization for each group are indicated in table 4. Calves of groups *KL* and *SL* gained in weight uniformly throughout the trial, whereas those in group *S* gained little or none during the first 2 wk., but they did increase in weight rapidly late in the experimental period.

Blood analysis. Average weekly levels of hemoglobin and cell volume

(hematocrit) and each of four plasma constituents are indicated in figure 1. These average values agree reasonably well with the normal levels for calves of this age (2, 18), although the hemoglobin levels tended to be higher and the inorganic phosphorus levels somewhat lower. Variation in serum magnesium (3) was greater than might be expected, but there did not appear to be any rela-

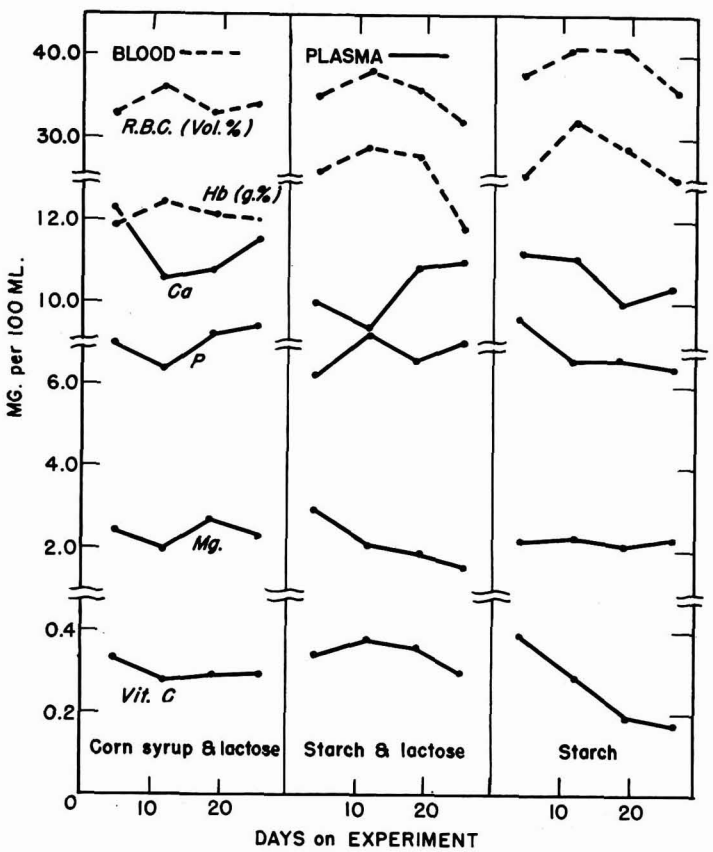

FIG. 1. Changes in the composition of the blood of calves.

tionship between the type of ration fed and the values obtained from the blood analyses.

Glucose absorption curves for each of the four carbohydrates tested, plotted from serial blood sugar determinations, are shown in figure 2. Blood sugar remained quite constant after starch ingestion and registered no increase during the first 4 hr. postprandially. Curves for the other three carbohydrates rose rapidly following feeding with little difference in evidence 30 min. after feed-

ing. Thereafter, the differences were striking. Corn syrup ingestion resulted in maximum blood sugar concentration 1 hr. after feeding, whereas the glucose or lactose peak was not reached until 4 hr. after feeding. The curve for glucose, however, descended more rapidly than did that for lactose. The maximum blood sugar concentration after corn syrup ingestion was only slightly more than half the maximum concentration following the consumption of glucose or lactose.

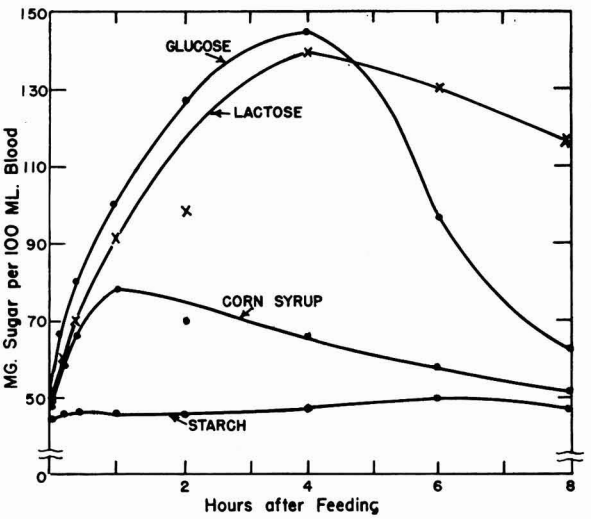

FIG. 2. Blood sugar concentration curves following ingestion of a single source of carbohydrate. Each curve is the average of three tests.

DISCUSSION

The single post-mortem examination performed was on a member of the *S* group and failed to reveal many of the lesions previously reported as characteristic of calves on a high-starch synthetic milk (4). Assuming that the animal examined was representative of the group, a possible explanation for the discrepancy in results may be found in the fact that in the earlier study the artificial milk contained natural feedstuffs high in starch. Pure corn starch added to these natural sources produced a higher level of starch feeding than was used in the present trial and may account for the differences noted in examining the experimental subjects.

The blood sugar level following starch ingestion showed no tendency to rise for the first 4 hr. after feeding (fig. 2). This might be anticipated, since starch is hydrolyzed slowly in the digestive tract. In fact, Shaw *et al.* (15) reported that the calf was unable to utilize starch to an appreciable extent until nearly 1 mo. of age. The glucose absorption curves obtained on a 2-wk.-old calf (4) substantiate this report in that there was no increase in blood sugar

over the 8-hr. sampling period. Since saliva of the bovine is devoid of amylolytic enzymes and pancreatic amylases are low in this species (17), the question is raised as to whether the failure of the neonatal calf to digest starch is due to (a) the inherent weakness of pancreatic amylase, with the result that the digestion of starch must await the development of starch-splitting microorganisms in the rumen, or (b) amylolytic activity of pancreatic (and/or possibly intestinal) juice is not developed at birth and fails to become efficient until several weeks after birth.

All data used in the preparation of figure 2 are from calves 28 to 35 days of age. The rapid rise in blood sugar following lactose ingestion is difficult to explain in that lactose presumably must be hydrolyzed before appreciable absorption can take place (12, p. 103). The continued high level of blood sugar would seem to indicate that the hydrolysis of lactose continues over a period of time. This may be considered to be advantageous in that energy is made available over an extended period and thus absorption and utilization are permitted to take place more efficiently. Blood sugar levels can be considered only as a rough index of the utilization of a carbohydrate. The concentration of blood sugar at any specified time depends upon the rate of absorption of the sugar into the blood stream and the rate at which it is removed from the blood. Removal may be accomplished through the kidneys or through utilization by the tissues, and the rate of removal, whether by excretion or utilization, varies with the sugar concerned (12, pp. 107, 133).

The alteration of response produced by adding lactose to either a corn syrup or a starch ration is remarkable. With corn syrup, the addition of lactose changed the response from no gain (5) to an average of over 28 lb. gain in 31 days (table 4). In the case of starch, lactose addition was accompanied by an increase in the rate of gain of 76 per cent (table 4). The differences are even more striking when one considers that the *KL* and *SL* groups surpassed not only the *K* and *S* groups in performance, but also the *L* group (5). Such results would not appear unusual in the study of proteins, in which the biological value of one protein may be increased greatly by the addition of a second protein (1). However, carbohydrates supposedly are hydrolyzed to the constituent monosaccharides before absorption can take place (12, p. 103) and supplementary relationships generally are not recognized in this class of compounds.

Although lactose possesses a lower specific dynamic effect than does glucose (8) and, thus, should be a more efficient source of energy, this slight advantage, when considered in conjunction with the relatively small amount of lactose included, certainly can not account for the differences obtained. Lactose, or specifically its constituent galactose, has been credited with increasing the utilization of fat (13). Lactose itself was reported to be antirachitic and to favor calcium metabolism in children as well as laboratory animals (6, 10, 11). By promoting an acid medium, lactose favors the absorption of both calcium and phosphorus, although Robinson *et al.* (14) expressed the belief that acidity was not the only factor. They suggested that lactose or the lactate ion may exert a specific action in facilitating passage of calcium into the blood. It is doubtful

that either calcium or phosphorus was a limiting factor in this study because the synthetic rations were high in these elements. The improbability of such a limitation is further indicated by the fact that the blood plasma levels of these elements were not affected adversely during the experiment. It was reported in the early 1900's that lactose exerts its beneficial influence by favoring desirable bacterial forms in the intestine (9). Perhaps this might be advanced as the logical explanation of the results in this experiment. Even so, it fails to explain the differences between the *KL* and *SL* groups of this experiment and the *L* group of the previous experiment. It would appear that lactose favorably influences the utilization of certain carbohydrates, as well as the utilization of fat. Regardless of the theoretical explanation, these results provide a basis for the common practice of including dry whey or non-fat dry milk solids in calf starters.

SUMMARY

Nine neonatal calves were allotted to three experimental groups and fed rations consisting of synthetic milks which varied only in the carbohydrate component.

Calves receiving corn syrup plus lactose (*KL*) gained an average of 28.33 lb., those receiving starch plus lactose (*SL*) gained an average of 24.67 lb., while calves on starch (*S*) averaged only 14.00 lb. gain in 31 days. The efficiency of feed utilization, expressed as pounds of gain per pound of dry matter consumed, was 0.487, 0.412 and 0.204 for the *KL*, *SL* and *S* groups, respectively.

Serial blood samples were collected before a test meal and at 0.25, 0.5, 1, 2, 4, 6 and 8 hr. after feeding and analyzed for blood sugar. The blood sugar level rose rapidly after the ingestion of glucose, lactose or corn syrup, with the maximum concentration at 4, 4 and 1 hr. respectively, after feeding.

Following starch ingestion there was no change in blood sugar the first 4 hr. and only a moderate increase at 6 and 8 hr.

The authors wish to express gratitude to Sheffield Farms Co., Inc., New York, N. Y., for donating a portion of the lactose used, to E. J. Benne for the chemical analyses of feed samples and to G. M. Trout for the use of the homogenizer.

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THE DIGESTION OF RUMEN MICROORGANISMS BY THE HOST ANIMALS

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Complete utilization of the nutrients synthesized in the rumen by the microflora and microfauna presupposes the later disintegration of the microorganisms in order that the products incorporated in their cells may be absorbed by the host animal. The concept that the rumen microorganisms are digested by the host animals after passage from the forestomachs is quite generally accepted (3). Hastings (9) states that ruminants live to a large extent on protozoa and bacteria which are constantly carried to the true stomach, killed and digested. On the other hand, McNaught and Smith (13) cite Köhler (12) as being of the opinion, based on comparative direct bacterial counts between rumen and intestinal contents, that very little protein in bacterial form is available to cattle. One of the principal details which support the supposition that rumen bacteria are later digested by the host animal is that ruminants can utilize non-protein nitrogen such as urea (4, 8, 13, 14 and 19). McNaught and Smith (13) consider that it would be almost impossible to explain this ability that ruminants possess for utilizing non-protein nitrogen as compared to other livestock such as pigs, rats and poultry, unless the conversion is accomplished by rumen microorganisms which later release their products to the host.

Johnson *et al.* (11) mentioned the possibility that the bacteria utilize products like urea, that the bacteria are later digested by protozoa and these, in turn, are digested by the host animal. Ciliates apparently are destroyed during their passage through the digestive tract as they disappear in the abomasum (1, 2, 6, 18). Baker (2) also has shown that they are digested by peptic and tryptic extracts.

According to Mangold, as cited by Johnson *et al.* (11), ruminants obtain much protein through their digestion of the infusoria which pass along from the rumen. However, the presence of protozoa apparently is not essential to ruminants (5), even for the utilization of urea (11). Hastings (9) interprets this to indicate that bacterial protein is as available to the host as that from protozoa. However, the protein derived from bacterial protein may be somewhat less easily digested by the host than that from protozoa (11, 13).

Baker (2) observed that iodophile bacteria of the rumen, although not affected by gastric secretions, are inconspicuous and present only in limited numbers in the caecum and feces of cattle and sheep and that partially digested microorganisms frequently are seen in caecal contents. The breakdown and disappearance, by the time the materials reached the caecum, of the strongly iodo-

Received for publication March 22, 1950.

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phile *Oscillospira* organisms which were prevalent in the contents of a sheep's rumen was reported by Baker and Harriss (3). They further mentioned the observation of residues of structural cellulose with enzymic cavities which lacked the bacteria which had produced them as the bacteria had been digested out. Autolysis of iodophile bacteria apparently occurs, according to Baker (2) who demonstrated it by using incubation in the presence of toluene. Large coccoids, morphologically similar to those seen in rumens, were observed by Pounden and Hibbs (15) in the feces of six out of seven samples from cows on mixed rations and in those from seven calves on hay and milk diets.

METHODS

It seemed possible that further information might be obtained regarding the fate of rumen bacteria as they progress down the digestive tract by investigating the presence of morphologically identifiable types in various sections or areas of the tract. The method would be somewhat similar to that mentioned by Baker and Harriss (3) for *Oscillospira*. Use was made of the four previously described bacteria which were characteristically found in the rumens of cattle ingesting an adequate proportion of roughage and which were utilized as "indicators" in determining the presence or absence of usual rumen flora in young calves (15, 16). The first consisted of large Gram-positive coccoids which previously were designated as composing hay flora group I. The second ones were the large cigar-shaped Gram-negative bacteria (probably *Oscillospira*). Small Gram-negative rods which tended to form in flat rectangular groups suggestive of window panes and large, thick Gram-positive rods frequently present in pairs were the remaining two used in this study. The latter three are the microflora which make up the previously described hay flora group II.

Gram-stained smears were made from the contents of the rumen and various other parts of the digestive tracts of cows and calves at slaughter. In order to remove the coarser materials, all samples were strained through a single layer of cheese cloth before the smears were prepared. Similar stained smears were made from samples of the contents of various parts of the tract to which rumen contents, particularly rich in the cigar-shaped rods, were added. Smears were made and repeated later to determine if changes occurred in the bacterial "indicators" following incubation of the samples at 37° C. or when kept under refrigeration.

Samples from all parts of the tracts were not always available, partly because some results are included which were obtained during the course of other studies in which only limited preparations were made. An attempt was made to estimate the relative concentrations of these organisms which were present in each preparation for purposes of comparison. Ratings between one and four were assigned on this basis.

RESULTS

It was noticed that smears made from abomasal samples sometimes would appear to contain greater concentrations of bacteria than did the rumen. The absorption of water just before passage of food into the true stomach, such as

was referred to by Savage and McCay (17), would be a possible explanation for this change. It also was noted that bacteria tended to be limited in numbers in the duodenum, to increase progressively in concentration down the tract and to become very numerous in the large intestines.

Large coccoids. Comparisons were made between 26 freshly obtained rumen samples in which these coccoids were present and samples from other parts of the tract. In seven instances, samples were available from the abomasum, and in all seven these organisms were present. They also were present in all 13 of the small intestine samples and in 22 of the 25 large intestine samples. Similar results were obtained for the few samples of abomasum and small and large intestinal contents which were refrigerated or incubated. The results are tabulated in table 1. Thus, it would appear that to quite an extent, these large

TABLE 1

The relative concentration of large coccoids in various parts of the intestinal tract of bovines

Animal	Rumen	Abomasum	Duodenum	Jejunum	Ileum	Caecum	Colon
Cow 600 J	1[a]	1	1	1	1	2	3
Cow 750 H	2	2	2	.....	2	1	.....
Cow 743 H	2	1	.....	.....	1	2	.....
Cow 851 H	2	2	.....	.....	2	2	.....
Cow 913 J	2	2	.....	.....	2	1	.....
Cow H	1	1	.....	.....	.....	.....	.....
Calf 1022 J	1	2	2	2	2	2	.....
Calf 1022 J + 24 hr. incubation	1	2	1	1	2	.....	.....
Cow H + 24 hr. incubation	1	1	.....	.....	.....	.....	.....
Calf 1022 J + 24 hr. refrigeration	1	2	.....	.....	.....	.....	.....
Calf 885 J+ 24 hr. refrigeration	1	1	1	1	1	1	1
Other calves: Present in rumen = 18; also present in caecum = 15	.....	.....	.....	.....	.....	.....	.....

[a] Rating: 1 = few; 2 = moderate numbers; 3 = many; 4 = masses.

coccoids are not sufficiently affected by passage through the digestive tract to render their nutrient content available to the host animals unless possibly when predigested by protozoa.

Very large cigar-shaped rods. The results obtained (table 2) agreed with the findings mentioned by Baker and Harriss (3) for *Oscillospira.* These large bacteria, although present in the rumens, were absent in all smears, freshly prepared at slaughter, from the contents of other parts. Included were one abomasal sample and two small and seven large intestinal samples. These organisms also were added to abomasal and intestinal samples by use of rumen material containing large numbers of them. They disappeared from the six abomasal and three small intestinal samples. This occurred in approximately 1 hr. at room temperature in the case of five of the abomasal samples, while the one remaining abomasal and the three small intestinal samples were not examined until after 24 hr. refrigeration. These bacteria still were visible in the two samples, one each from the caecum and colon, which were kept refrigerated for 24 hr. after being added.

These large cigar-shaped organisms evidently are destroyed by contact with abomasal and small intestine contents but not by the contents of the large intestines, at least under conditions of refrigeration. Under natural conditions,

TABLE 2

The relative concentration of large cigar-shaped bacteria in various parts of the intestinal tract of bovines

Animal	Rumen	Abomasum	Duodenum	Jejunum	Ileum	Caecum	Colon
913 J	2[a]	0	0	.....	0	0	0
913 J + added bacteria + 1 hr. room temperature	1	0	.....	.....	.....	.....	.....
750 H + added bacteria + 1 hr. room temperature	1	0	.....	.....	.....	.....	.....
743 H + added bacteria + 1 hr. room temperature	1	0	.....	.....	.....	.....	.....
851 H + added bacteria + 1 hr. room temperature	1	0	.....	.....	.....	.....	.....
1022 J + added bacteria + 1 hr. room temperature	1	0	.....	.....	.....	.....	.....
600 J + added bacteria + 24 hr. refrigeration	4	0	0	0	0	2	3
Other calves: Present in rumen, but absent in caecum = 6	.....	.....	.....	.....	.....	.....	.....

[a] Rating: 1 = few; 2 = moderate numbers; 3 = many; 4 = masses.

they would never, of course, reach these posterior parts of the intestinal tract.

Small rods in flat rectangular groups. Groups of these organisms were readily detected in smears of seven abomasal samples, even though not visible in one of the rumen samples collected at the same time (table 3). They were observed in eight of the possible eleven samples from the small intestines of ani-

TABLE 3

The relative concentration of small rods formed in flat rectangular groups in various parts of the intestinal tract of bovines

Animal	Rumen	Abomasum	Duodenum	Jejunum	Ileum	Caecum	Colon
600 J	2[a]	2	1	1	1	2	1
750 H	0	1	0	.....	0	1	.....
743 H	2	2	.....	.....	1	1	.....
851 H	3	2	.....	.....	2	2	.....
913 H	1	2	.....	.....	1	1	.....
H	2	2	.....	.....	.....	.....	.....
1022 J	1	1	0	0	0	0	.....
1022 J + 24 hr. incubation	0	1	.....	.....	.....	.....	.....
H + 24 hr. incubation	1	1	.....	.....	.....	.....	.....
1022 J + 24 hr. refrigeration	1	1	.....	.....	.....	.....	.....
885 J + 24 hr. refrigeration	1	1	.....	.....	1	1	.....
Other calves: Present in rumen = 4; but absent in caecum = 3							

[a] Rating: 1 = few; 2 = moderate numbers; 3 = many; 4 = masses.

mals which had these bacteria in their rumens. These organisms were present in six samples from the large intestines of similar animals. Unfortunately, few

organisms were present in the rumen of one animal from which were obtained three small intestinal samples that lacked these bacteria along with one similar large intestinal one. Consequently, it is possible that the concentration was too low to permit their detection. Refrigeration and incubation both failed to change the results in the few instances when they were used.

It was possible, therefore, to observe these organisms in samples from the abomasum as well as the intestines. In samples from the large intestine, and sometimes the ileum, groups of these organisms appeared to be breaking apart and stained irregularly. In previous examinations these bacteria were not visible in smears made of fecal samples from both cows and calves. They were not established in the rumen of a calf into which were placed feces from another calf which had received several rumen inoculations with cud materials (15). Thus, it is probable that these bacteria, although visible in samples from the caecum and colon, are in process of disintegration in these organs.

Large thick rods. These organisms were readily observed in the seven abomasal samples from animals which also had them in their rumens (table 4).

TABLE 4

The relative concentration of thick square-ended rods in various parts of the intestinal tract of bovines

Animal	Rumen	Abomasum	Duodenum	Jejunum	Ileum	Caecum	Colon
600 J	1[a]	1	1	0	0	1	0
750 H	1	1	1	.....	1	1	.....
743 H	2	2	.....	.....	1	1	.....
851 H	1	2	.....	.....	2	1	.....
913 J	2	2	.....	.....	2	1	.....
H	2	2	.....	.....	.....	.....	.....
1022 J	1	1	0	0	0	0	.....
H + 24 hr. incubation	2	2	.....	.....	.....	.....	.....
1022 J + 24 hr. incubation	1	1	.....	.....	.....	.....	.....
1022 J + 24 hr. refrigeration	1	1	.....	.....	.....	.....	.....
Other calves:							
Present in rumen, but absent in caecum = 9	.....	.....	.....	.....	.....	.....	.....

[a] *Rating*: 1 = few; 2 = moderate numbers; 3 = many; 4 = masses.

They were detectable in six out of eleven small intestine examinations and in five out of sixteen large intestine trials. They were not observed in any of the caecal smears from ten calves which had some present in their rumens. This may indicate a difference between calves and cows. However, the smallness of the numbers available to pass through, coupled with the density of bacteria in caecal samples, may have been responsible for this difference in results. Nonetheless, in one caecal sample from a cow, they were observed to be few and to stain in an irregular manner as though decomposing. It also is noticeable that they were not observed during previous investigations in fecal samples from seven cows and seven calves even though some were known to be present in the rumens of the latter (15). Neither were they established in the rumen of a calf which received, per stomach tube, feces from a calf whose rumen contained them. In the few instances in which a check was made, these organisms

were not visibly affected by abomasal fluids during either incubation or refrigeration for 24 hr. It would seem, therefore, that these thick rods may disintegrate in the posterior parts of the tract.

Protozoa. Even though rumen samples from the slaughtered animals used in the above experiments frequently had large numbers of protozoa, these were noticeably absent from abomasal samples. To four abomasal samples which had been held in refrigeration over night, rumen fluid containing large numbers of ciliates was added in the proportion of three parts of the former to one part of the latter. The mixtures were held at room temperature. Motility of all but a few ciliates was halted almost immediately. After 45 min., the vast majority of the ciliates had collapsed and disintegrated or had become swollen and appeared to be ready to disintegrate. The swelling of the protozoa probably occurred prior to the disorganization phenomena mentioned by Baker (1), during which he says the cytoplasm shrinks, the meganucleus becomes deformed and the skeletal rods dissociate.

DISCUSSION

The results of this study are far too limited to permit any deductions regarding rumen microflora in general. However, based on the observations made on these four bacterial types, it would be logical to surmise that some organisms undergo rapid disintegration shortly after encountering abomasal fluids. Others manage to hold their form until they reach the more posterior parts of the digestive tract, while still others can withstand all the post-ruminal digestive activities of the animals. A possible means whereby microflora of the latter type could become of value to the host would be through predigestion by the protozoa.

It has been observed that the caecal flora of mice will change greatly depending on the feeds eaten (7), and high milk diets have considerable influence in this respect on rats (10). This situation also could quite conceivably apply to calves. In this way differences in the feeds ingested might possibly result indirectly in differences in the bacterial enzymes produced in the caecum and in the ability of this organ to disintegrate the rumen bacteria which enter.

SUMMARY

Observations were conducted on samples from various parts of the digestive tract of cattle for the presence of four types of bacteria characteristically present in rumen samples from cattle. Evidence was being sought regarding the availability of bacterial products to the host.

The first of the four organisms were larger coccoids. Some of them were observed in all parts of the digestive tract, although sometimes apparently in less concentration in the more posterior parts of the large intestine. The second, which were large cigar-shaped organisms, disappeared in the abomasum and were missing in the remainder of the tract. On addition to samples of the contents of the abomasum and small intestines, they were destroyed but not so by those samples from the large intestine.

The third type was composed of small rods which formed in flat rectangular

groups. These appeared to disintegrate gradually as they reached the posterior parts of the tract, although some were observed in samples from the caecum and colon. The same apparently was true of the bacteria of the fourth group, which were thick square-ended rods.

The destruction of protozoa by abomasal fluids, reported by others, was confirmed in this study.

It is concluded from the data, although somewhat limited, that the ultimate fate of rumen microorganisms varies between the extremes of complete destruction in the abomasum to passage entirely through the digestive tract of the host.

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THE EFFECTS AND INTERRELATIONSHIP OF COPPER, IRON AND PASTEURIZING TEMPERATURE ON THE STABILITY OF ASCORBIC ACID ADDED TO SKIMMILK

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The increasing use of synthetic ascorbic acid in milk and milk products places more emphasis on knowledge of the factors affecting its stability, and a wider use of nutritionally significant quantities of iron and copper in milk products has intensified the problem of metal catalysis of oxidation.

The catalysis of ascorbic acid oxidation by copper is well known. Barron and DeMeio (2) and Marston (15) concluded that copper but not iron catalyzed the oxidation of ascorbic acid, but that iron increased the catalytic power of copper and that in all except very highly purified solutions copper was present in sufficient quantity to make the iron appear to be independently catalytic. Because of the natural occurrence of iron and copper in milk, the effects of the two metals cannot be studied separately at the zero level of either and for practical purposes they both may be considered oxidation catalysts.

In studies on the stability of ascorbic acid in milks during processing, storage and use, numerous investigators have noted the destructive effects of added copper (8, 9, 10, 11, 14, 20, 23, 24), the superiority of high temperature pasteurization over holder pasteurization with regard to the losses of ascorbic acid incurred in pasteurization and in subsequent storage and use (11, 14, 16, 23) and the effects of added iron (23). However, there do not appear to be any comprehensive studies on the effect of the concentration of one of the metals upon the activity of the other and on the effects of temperature of pasteurization as related to copper and iron content.

It was the object of this work to study some of the effects and interrelationships of copper, iron and temperature of pasteurization, upon the stability of ascorbic acid added to skimmilk after pasteurization.

EXPERIMENTAL

Skimmilk was chosen in preference to whole milk because the ascorbic acid oxidation in milk occurs in the aqueous phase and because skimmilk was obtainable from day to day as a more nearly uniform material. The experimental work was designed to determine the comparative effects of the various combinations of the three variables on the stability of ascorbic acid added to the milk after pasteurization during a fixed 16-hr. incubation period under standard experimental conditions. Incubation conditions were chosen to allow sufficient excess of oxygen. The ascorbic acid oxidation in skimmilk under our experi-

Received for publication March 22, 1950.

mental conditions has been shown in previous work in this laboratory (4) to approximate a first order reaction as in water solutions (13, 22). The levels of copper used were 0, 0.1, 0.2 and 0.4 ppm.; of iron, 0, 2, 5 and 10 ppm. Temperatures of pasteurization were 50, 65, 75, 85 and 95° C. The control unpasteurized samples were held at 35° C. for parallel times. A 30-min. pasteurizing time was used throughout, except when effect of length of heating time was studied.

Materials. Except for the samples milked into glass and contacting only glass throughout the experiments, the milk used was a composite sample of raw skimmilk 6 to 18 hr. old, of grade A fluid milk quality obtained daily from a cream separator connected to a 2,000-gal. receiving tank. It had been handled principally in tinned and steel equipment. Milk free from metal contamination was milked into glass, cooled in the receiving flask, centrifuged in glass and the experimental procedure started within 5 hr. of milking time. A composite sample of milks handled entirely in glass contained 0.1 mg. of copper per liter and 0.48 mg. of iron per liter. A composite sample of "receiving plant" milks contained 0.2 mg. of copper per liter and 1.2 mg. of iron per liter.

CP cupric sulfate and U.S.P. ascorbic acid were used. The CP ferrous sulfate used contained 0.01 per cent copper which, at the maximum iron addition of 10 ppm., contributed 0.005 ppm. of copper to the milk.

In the work on milk having no metal contamination, all equipment was Pyrex, washed with nitric acid and finally rinsed with water redistilled from Pyrex. This double-distilled water was used for solutions and for all additions to the milk samples.

Procedure. One metal was added as a concentrated solution to a bulk volume of the milk. For each sample, 490 ml. of this milk then were placed in a 1000 ml. Erlenmeyer flask and, if both metals were being investigated, 5 ml. of a freshly made solution of the other metal were added or 5 ml. of water were used when only one metal was to be added. The sample was heated immediately in a water bath at the required temperature ($\pm$ 1° C.) with intermittent shaking. After heating, the sample was cooled rapidly to 35° C. in cold water, water was added to replace that lost by evaporation and the flask tightly stoppered and held in a 35° C. incubator in the dark for about 1 hr. to reach equilibrium conditions. Ascorbic acid at a level of 100 mg. per liter, was added as 5 ml. of a freshly made solution.

Fifty ml. were immediately withdrawn for the zero-hour ascorbic acid determination. Three hundred ml. were discarded, 0.5 ml. of toluene added as a preservative to the remaining 150 ml. and the flask tightly stoppered. The sample was incubated in the dark at 35° C. for 16 hr. and the loss of reduced ascorbic acid determined.

Methods of assay. Reduced ascorbic acid was determined by the colorimetric indophenol dye-xylene extraction method of Nelson and Somers (18) with 3 per cent HPO_3 as an extractant. Since the data are intended primarily to be comparative, assay was made for reduced ascorbic acid only without correction for interfering substances.

Iron was determined by the alpha-alpha' dipyridyl method of the A.O.A.C. (1). Copper was determined by the method of Bendix and Grabensetter (3).

RESULTS

Effects of time of pasteurization. Figure 1 shows the effects of heating time at several pasteurizing temperatures, on the stability of reduced ascorbic acid added after pasteurization to milk containing 0.1 ppm., added copper.

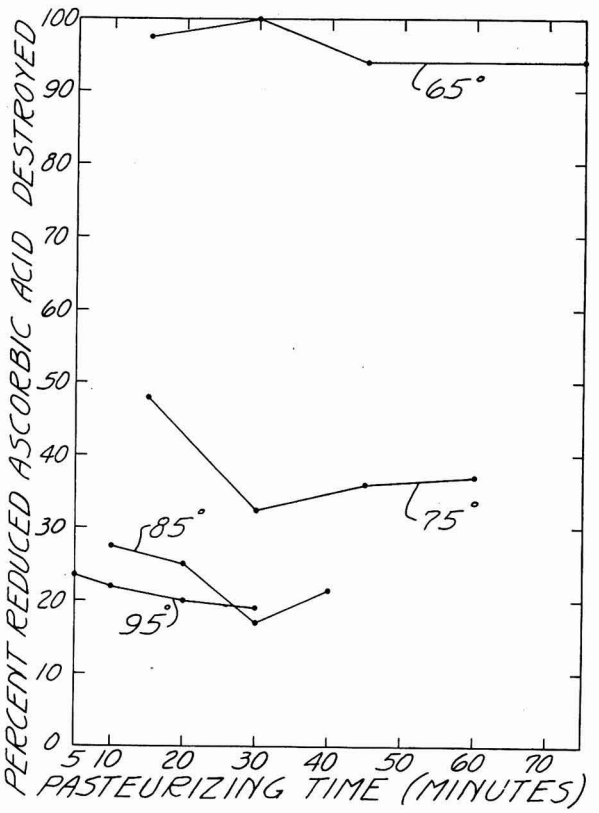

FIG. 1. Effects of time of pasteurization at several temperatures on the stability of reduced ascorbic acid added to skimmilk after pasteurization. "Receiving plant" milk containing 0.1 ppm. added copper. Reduced ascorbic acid loss in parallel sample not pasteurized was 35.6%.

At 65° C., maximum loss occurred in samples heated for 30 min. and no significant decrease in loss was effected by heating up to 75 min. At 75 and 85° C., a minimum loss was noted for the samples heated for 30 min., although the increase in loss in samples heated for a longer time was not great. At 95° C.

the ascorbic acid was practically as well retained in samples heated 5 min. as in those heated for a longer time. Except in samples heated at 85 and 95° C., the differences in the effects of temperature of heating were considerably greater than the effect of time of heating at a given temperature.

A 30-min. heating period which represents a compromise between adequate pasteurization at low temperatures and avoidance of excessive heating of the milk at high temperatures was chosen for the remainder of the experiments.

Effects of temperature of pasteurization in milks of low copper and iron content. Figure 2 shows the differences in ascorbic acid stability in milk handled in glass and in "receiving plant" milk at various pasteurizing temperatures. The large differences in stability of ascorbic acid added after pasteurization at various temperatures with a minimum stability in samples pasteurized

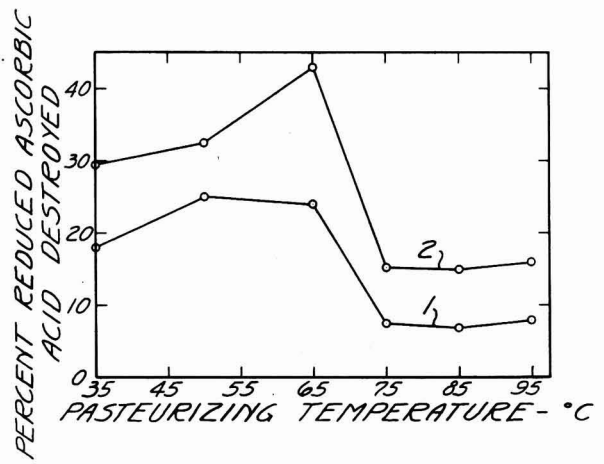

FIG. 2. The effects of pasteurizing temperature on the stability of reduced ascorbic acid added after pasteurization, in: (1) skimmilk handled entirely in glass, average of 2 trials; and (2) "receiving plant" skimmilk, representative trial of 3 trials.

at 65° C. indicate that the heat effects are complex. The destruction of ascorbic acid which occurs in milk handled entirely in glass presumably is due to the copper, iron and other pro-oxidants present in milk as secreted.

The increase in ascorbic acid loss in the "receiving plant" milk, as compared to the milk handled in glass was about constant except for samples pasteurized at 65° C. and probably is due to copper and iron contamination.

Effects of temperature of pasteurization and added copper. The effects of added copper at the various temperatures are shown in figure 3. The ascorbic acid losses due to the added copper in the "receiving plant" milk are assumed to be the differences between losses at each copper level and the losses in parallel samples of "receiving plant" milk containing no added copper.

The ascorbic acid losses caused by the added copper varied considerably

with pasteurizing temperature. Significant is the sharp increase in loss in the 65° C. samples. For milk containing up through 0.2 ppm. added copper, pasteurization at from 75 to 95° C. eliminated substantially the ascorbic acid losses caused by the copper. In the unheated samples (35° C.) and at the lower temperatures, the increases in ascorbic acid losses were roughly proportional to the added copper, but the proportionality did not hold at 85 and 95° C.

Effects of temperature of pasteurization and added iron. Figure 4 shows the effects of added iron. As with added copper, the greatest ascorbic acid losses occurred in the samples heated at 65° C., although the losses in the 50° C. samples were relatively greater in comparison to the 65° C. samples than with

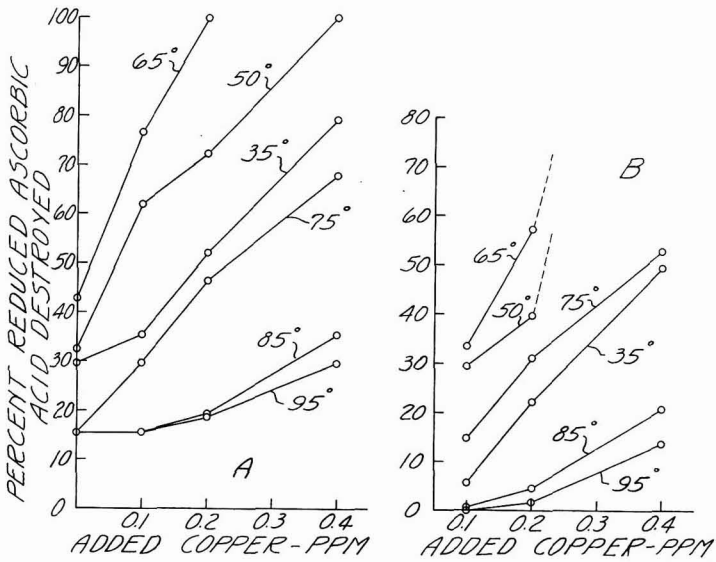

FIG. 3. Effects of pasteurizing temperature on the stability of reduced ascorbic acid added to "receiving plant" skimmilk after pasteurization, at several levels of added copper: A, reduced ascorbic acid losses at the various pasteurizing temperatures; B, losses assumed to be due to the added copper. Representative trial of 3 trials. 100% loss points indicate oxidation of all reduced ascorbic acid at an unknown time prior to 16 hr.

copper. As for copper, the loss of ascorbic acid due to the added iron varied with pasteurizing temperature but over a much smaller range, and ascorbic acid losses in the milk pasteurized at the higher temperatures were relatively greater. The 16-hr. ascorbic acid losses in the milk handled in glass and with iron added were much lower than for "receiving plant" milk pasteurized at the same temperature (85° C.), and the losses due to the added iron also were lower.

Effects of temperature of pasteurization and added copper and iron in combination. Figure 5 shows the effects of addition of both copper and iron in a

series of samples in which the added copper was 0.2 ppm. and the added iron was varied. Figure 6 shows parallel data at an added copper level of 0.4 ppm. Incomplete data was obtained, as the 16-hr. incubation proved more than enough time for complete oxidation with the higher concentrations of the metals. The losses due to the added iron are assumed to be the differences between the losses at the given iron level and those for samples at the same added copper level but with no added iron. As the copper content was increased, the effect of added iron decreased at 50 and 65° C.; temperatures at which ascorbic acid losses caused by copper were high. Thus, in the 50° C. samples, the ascorbic acid

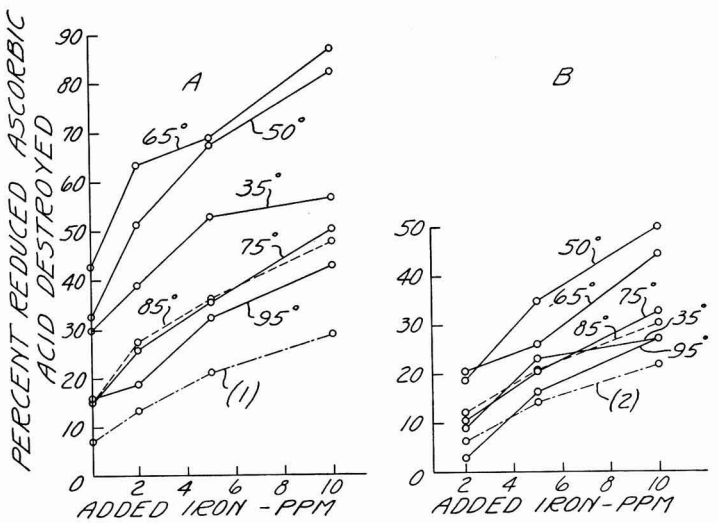

FIG. 4. Effects of pasteurizing temperature on the stability of reduced ascorbic acid added to "receiving plant" skimmilk after pasteurization at several levels of added iron: A, reduced ascorbic acid losses at the various pasteurizing temperatures; B, losses assumed to be due to the added iron. (1) Reduced ascorbic acid losses in and (2) losses due to iron added to milk handled in glass pasteurized at 85° C.

losses caused by 5 ppm. of added iron were reduced from 35 to 18 to 0 per cent as the added copper content was increased from 0 ppm. (figure 4) to 0.2 ppm. (figure 5) to 0.4 ppm. (figure 6). However, in the high temperature samples in which the ascorbic acid losses caused by copper were low, the effect of the added iron remained more nearly the same at all three levels of added copper. In the 95° C. samples losses caused by 5 ppm. added iron in the presence of 0, 0.2 and 0.4 ppm. added copper were 14.5, 17 and 17 per cent, respectively.

DISCUSSION

Pro-oxidant activity of copper varies widely with the state of combination of the copper, and complexes of the metal have been prepared that show no pro-

oxidant activity. It has been shown that the rate of oxidation of ascorbic acid by oxygen can be used to estimate the concentration of copper having pro-oxidant activity (4, 6, 10, 19, 22).

Therefore, it may be assumed that the rate of ascorbic acid oxidation in skimmilk under fixed experimental conditions, including a constant composition of the milk, particularly a constant iron content, is an approximate measure of the pro-oxidant activity of the copper present and that the effects of heating milk on the rate of ascorbic acid oxidation are due to formation of complexes of varying pro-oxidant activities. According to these assumptions, the pro-oxidant activity of copper in milk shows marked variation with pasteurizing temperature.

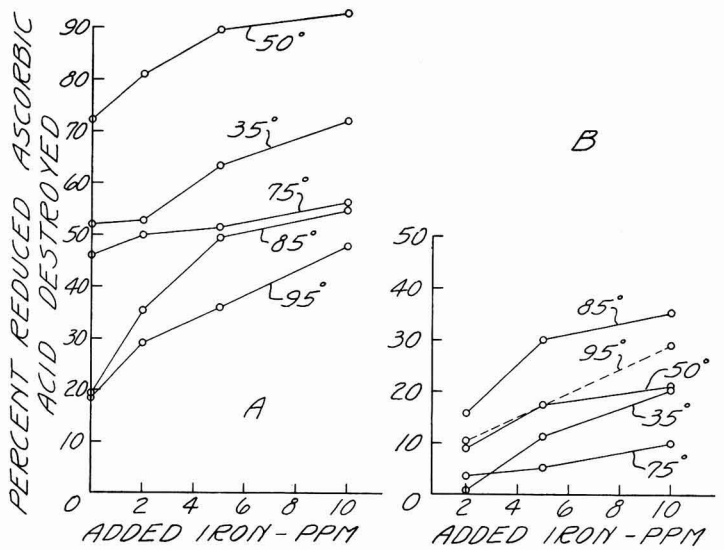

FIG. 5. Effects of pasteurizing temperature on the stability of reduced ascorbic acid added after pasteurization to "receiving plant" skimmilk containing 0.2 ppm. added copper, at several levels of added iron: A, reduced ascorbic acid losses at the various pasteurizing temperatures (at 65° C., 100% destruction of the reduced ascorbic acid occurred in all samples); B, losses assumed to be due to the added iron—calculated by subtracting loss for equivalent point in "receiving plant" milk containing 0.2 ppm. added copper and no added iron. 1 trial.

Native, undenatured proteins have metal complexing properties (21) and both the naturally occurring and added copper of unheated milk is present in complex form (4, 17). Greater ascorbic acid losses were found after heating at 65° C. than at 55° C. or for unheated samples (35° C.) so it may be that heating at this intermediate temperature reduces the concentration of naturally occurring copper complexing substances of milk to a minimum; 65° C. is below the point of significant protein denaturation or formation of sulfhydryl groups (5). Heating at temperatures above 65° C. results in a decreased rate of as-

corbic acid oxidation presumably due to copper inactivation. The principal mechanisms of inactivation of copper at higher temperatures probably are the formation of complexes with protein (4, 7) and with sulfhydryl groups produced by heat (4, 5, 11) which are less active than the copper complexes present in unheated milk. Heating 30 min. at 95° C. appears to be sufficient to practically inactivate up through 0.2 ppm. of added copper.

Though the behavior of iron is most correctly expressed in terms of its effect on the catalytic power of copper, as a practical matter, in milk of low copper content, it can be expressed as pro-oxidant activity in a manner allowing com-

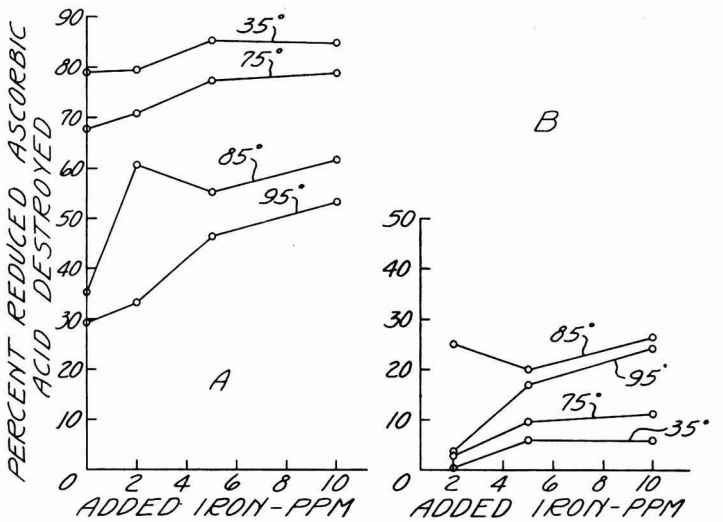

FIG. 6. Effects of pasteurizing temperature on the stability of reduced ascorbic acid added after pasteurization to "receiving plant" skimmilk containing 0.4 ppm. added copper, at several levels of added iron: A, reduced ascorbic acid losses at the various pasteurizing temperatures (at 65° C., 100% destruction of the reduced ascorbic acid occurred in all samples); B, losses assumed to be due to the added iron—calculated by subtracting loss for equivalent point in "receiving plant" milk containing 0.4 ppm. added copper and no added iron. 1 trial.

parison with the effects of copper. Figure 7 compares the pro-oxidant effects of copper and iron in the "receiving plant" milk at intermediate added levels of each metal (specifically this data represents the effects of added copper in the presence of about 1.2 mg. per liter of iron and the effects of added iron on the pro-oxidant activity of about 0.2 mg. per liter of copper). The pro-oxidant activity of iron was much less than that of copper. In milk stored at 35° C. the activity of copper was 24 times as great as iron in samples not heated, 55 times as great in samples heated 30 min. at 65° C. and only 4 times as great in the 95° C. samples. The activity of iron varied with temperature of heating but showed only a two-fold change throughout the range of pasteurizing tempera-

tures as against a twenty-fold variation for copper. Iron showed a maximum activity after heating at 50° C. instead of at 65° C. and heating up to 95° C. did not appear to cause inactivation. Successive increments of added iron caused successively less increase in ascorbic acid loss, except in the milk heated at the higher temperatures in which the pro-oxidant copper content was very low (figure 8).

Joslyn and Miller (13) have demonstrated a reduction of the pro-oxidant activity of copper by iron in neutral water solutions of ascorbic acid. In water solutions of pH 7.0 buffered with H_3PO_4, containing 50 mg. of ascorbic acid per liter, 0.07 ppm. copper and 0.07 ppm. iron, the rate constant for oxidation of ascorbic acid at −1.1° C. was reduced from 5.19 to 1.46 $hr.^{-1}$ by increasing the

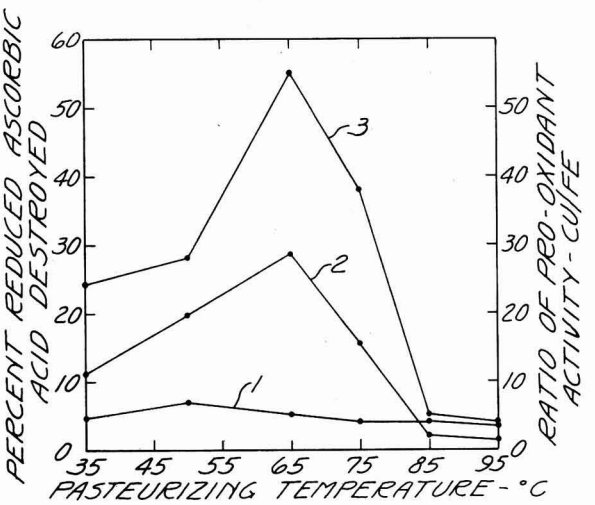

FIG. 7. Comparison of the pro-oxidant activity of copper and iron in milk after 30-min. pasteurization at various temperatures: (1) reduced ascorbic acid loss caused by 1.0 ppm. added iron in "receiving plant" milk containing 5.0 ppm. added iron and no added copper; (2) loss caused by 0.1 ppm. added copper in "receiving plant" milk containing 0.2 ppm. added copper and no added iron; (3) ratio of losses caused by equal concentrations of the metals—copper/iron.

iron content to 11.31 ppm. With milk the data suggest, besides the iron reactions which act to increase the catalytic power of copper, reactions acting to prevent the destruction of ascorbic acid. Within the ranges of copper and iron investigated here, the 16-hr. incubation ascorbic acid loss in milk containing a given amount of pro-oxidant copper was always made greater by the addition of iron. The opposing reaction preventing oxidation of ascorbic acid is illustrated in figure 8 in which the 16-hr. ascorbic acid loss caused by the addition of 0.2 ppm. copper at zero added iron level is compared with the losses caused by this copper in the presence of 2, 5 and 10 ppm. added iron. Here, after heating at 50 and 65° C. where pro-oxidant copper level presumably is high,

the loss caused by the added copper is steadily reduced as the iron content is increased.

As a result of the occurrence of these two opposing reactions the stability of the ascorbic acid could be the same over a range of copper and iron concentrations. This would explain the observation (figure 8) that the increase in ascorbic acid loss caused by addition of 0.2 ppm. copper would (as indicated by the intersection of the curves representing the losses caused by this copper) remain the same in milk containing 0, 2, or 5 ppm. added iron and pasteurized at about 81° C.

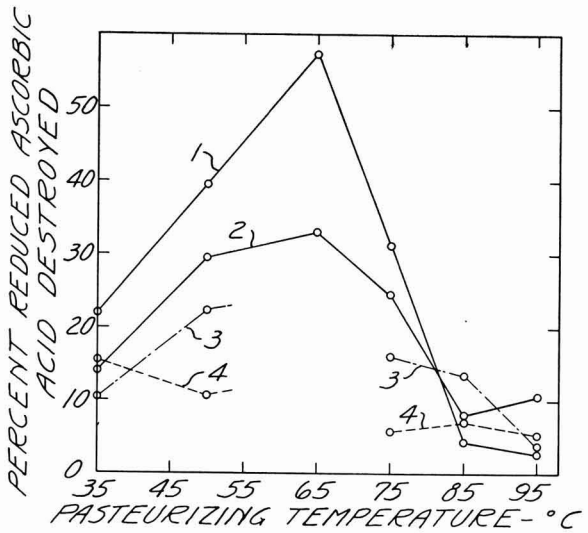

FIG. 8. Effect of added iron on the pro-oxidant activity of added copper as measured by the rates of loss of reduced ascorbic acid added after pasteurization to "receiving plant" skimmilk pasteurized at several temperatures. A 16-hr. reduced ascorbic acid loss caused by 0.2 ppm. added copper in the presence of (1) zero added iron; (2) 2 ppm. added iron; (3) 5 ppm. added iron; and (4) 10 ppm. added iron. Calculated by subtracting the ascorbic acid loss occurring at each level of added iron in milk containing no added copper from that occurring with 0.2 ppm. added copper. Data is incomplete at 65° C.

SUMMARY

The effects of copper, iron and temperature of pasteurization on the stability of ascorbic acid added to skimmilk after pasteurization, and the interrelationship of these variables have been investigated.

1. Pasteurization at temperatures up to 65° C. decreases the stability of ascorbic acid added after pasteurization. Minimum stability occurs at about 65° C. and the ascorbic acid is markedly more stable in milk pasteurized at 75° C. or higher than at 65° C. and in unheated milk.

2. Ascorbic acid added after pasteurization is significantly more stable in

skimmilk handled entirely in glass than it is in grade A fluid quality skimmilk having known copper and iron contamination. The stability of ascorbic acid varies with pasteurizing temperature in the uncontaminated milk in a manner similar to the variation in skimmilk containing added copper and iron, indicating that part of the ascorbic acid losses in uncontaminated milk are caused by the naturally occurring copper and iron.

3. The effect of added copper in the oxidation of ascorbic acid in milk varies widely with pasteurizing temperature. Heating to 65° C. greatly increases the pro-oxidant activity of copper. It then decreases sharply with increases in temperature, and heating to 85 or 95° C. inactivates up through about 0.3 ppm. total copper content.

4. The effect of added iron on the oxidation of ascorbic acid in milk varies with pasteurizing temperature, but over a comparatively smaller range than for copper. The pro-oxidant effect of iron appears to be at a maximum after heating at 50° C. and heating at 95° C. does not decrease the activity greatly.

5. Within the range of added metals investigated, all combinations of added iron and copper caused more rapid ascorbic acid loss than the same level of either metal alone. Under conditions in which the level of pro-oxidant copper presumably was high, however, the ascorbic acid loss caused by each part per million of iron became smaller as the iron content was increased. After heating at 50 and 65° C., the addition of a given amount of copper to milk caused successively smaller increases in ascorbic acid loss rate as the iron content of the milk was increased.

6. The behavior of copper and iron in combination suggests two opposing reactions involving copper, iron and ascorbic acid. The first tends to cause more rapid oxidation of the ascorbic acid, while the second acts to prevent oxidation. The net pro-oxidant effect of the combination of the metals is the resultant of these reactions.

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THE EFFECT OF RUMEN INOCULATIONS ON THE DIGESTIBILITY OF ROUGHAGES IN YOUNG DAIRY CALVES

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Conditions in the rumens of cattle fed normal rations are favorable for the growth and multiplication of rumen bacteria and protozoa. It has been shown (9, 10) that most, if not all, of the digestive action in the rumen is due to the functions of these microorganisms.

Several reports (1, 2, 6, 7, 8, 10) have established the fact that the digestibility of fiber by ruminants can be influenced by certain dietary factors. Mangold (10) suggested that the differences in digestibility associated with changes in dietary constituents were related to changes in the gastro-intestinal flora and fauna. This is of interest in view of the recent findings concerning the rumen microbiological picture of young calves by Pounden and Hibbs (11). They reported that under conditions of isolation no more rigid than found on many dairy farms, certain rumen microorganisms characteristically found in normal adult cattle may not become established for many weeks or months. However, when calves were inoculated with bits of cud material from the rumens of normal adult cattle and fed with suitable dry feeds the characteristic rumen microorganisms were established in the rumens of most calves by the time they were 3 wk. of age and in all calves in less than 6 wk. They showed in further investigations (12) that, when the ratio of grain to hay was such that the major part of the rumen ingesta was grain, rumen conditions were unsuitable for either the establishment or growth and multiplication of characteristic indicator microorganisms. When the establishment of characteristic microorganisms was previously accomplished, a decrease in numbers and eventually their disappearance was observed when a high proportion of grain (more than equal parts of grain in proportion to the hay) was included in the ration.

It seemed logical to assume that calves in which characteristic rumen microorganisms are established should be able to digest roughage more efficiently than calves in which these microorganisms are absent or which must depend on a substitute flora and fauna quite different from that normally found in the rumens of adult cattle. Therefore, an experiment using balance trials was conducted in an attempt to determine possible differences in roughage digestion between rumen inoculated and uninoculated calves fed various kinds and amounts of roughage.

EXPERIMENTAL

The 32 digestion trials to be reported were conducted using ten male Jersey calves.

Received for publication March 30, 1950.

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Hay samples were taken from each bale as it was opened. Hay refused by the calves was carefully recovered at the end of each digestion trial. Both the hay fed and the portion refused were weighed, ground and sampled for chemical analysis.

The calves were bedded with straw ticks made from feed bags. This measure was instituted for the two-fold purpose of preventing the experimental calves from consuming bedding and facilitating quantitative collection of the refused hay.

Feces were collected in triangular bags cut from a rubberized fabric. The feces bags were attached by safety pins to a light canvas calf blanket. The feces bags were changed daily between 8:00 and 10:00 a.m. Wet feces were weighed in the bag and the tare weight subtracted. Immediately, the 24-hr. feces collection was placed in a moisture proof cellophane bag and mixed by kneading for several minutes, depending on the consistency of the feces.

Dry matter was determined on two 200-g. samples of wet feces by oven drying at 100° C. for 24 hr. Two 100-g. samples of hay and pasture were dried similarly for 16 hr. in order to determine the dry matter.

Cellulose was determined by the method of Crampton and Maynard (3). However, digestion of the raw sample was carried out in 50-ml. centrifuge tubes as suggested by Hale *et al.* (5). Considerable foaming was encountered, which necessitated washing down the sides of the flask 5 min. after digestion was started.

The method described by Pounden and Hibbs (11, 13) was used for microbiological examinations of the rumen contents of the calves on the experiment at frequent intervals.

Experiments with inoculated and uninoculated calves. Ten male Jersey calves which were dropped during March, April and May in the Ohio Agricultural Experiment Station herd were assigned to either group I or II. Calves assigned to group I were removed from their dams after 1 day and placed in another barn to prevent natural inoculation of the rumen from association with their dams. The dam's colostrum was saved and fed from a pail until the end of the third day, after which the calves were fed whole milk from the Holstein herd at the rate of 0.9 lb. per 10 lb. of live weight, based on the birth weight. This limited amount of milk was fed in order to encourage early roughage consumption. When the calves were removed from the cow, they were provided good quality, third cutting alfalfa hay, free choice. A 4-wk. preliminary period was allowed for calves to begin roughage consumption and attain a somewhat constant daily intake. This plan was altered in the case of the three uninoculated calves, numbers 4, 2 and 8. These calves did not begin eating appreciable amounts of hay until after the fourth, sixth and seventh weeks of age, respectively. At the conclusion of the preliminary period, the first and second digestion trials were conducted for two successive 7-day periods.

Sterilized pails were used for feeding the uninoculated calves. These calves were handled routinely and fed first during all phases of the experiment. Pans

of disinfectant were provided at the entrance of the calf pens for cleaning the attendants' boots.

Calves in group II (inoculated) were treated as group I (uninoculated), except that they were housed without taking special precautions to prevent rumen inoculation through contact with other cattle. The calves in group II also were inoculated with rumen microorganisms by taking small pieces of cud from adult cows in the herd and placing them in the mouths of the calves on the 11th, 16th, and 21st days of age. Extended initial preliminary periods were required for two inoculated calves (5 and 6) since they did not begin eating appreciable amounts of hay until after the fourth week of age.

In a third series of trials, three calves from each group were placed on a ration of alfalfa hay *ad libitum*. A preliminary period of 7 days was followed by a 7-day digestion trial.

Following the trials on alfalfa hay *ad libitum,* two calves from each group were used for a fourth series of trials in which freshly-cut lawn clippings were fed daily. In order to facilitate measuring the amount consumed, the two pairs of calves were housed in the barn. Fresh lawn grass, mostly bluegrass and white clover, was clipped, weighed, sampled and fed to the calves daily. The refused clippings were collected at the end of the week. As in other trials, the fourth digestion period was preceded by a 7-day preliminary period.

Experiment in which alterations of the rumen microflora and microfauna were made by heavy grain feeding. According to the evidence of Pounden and Hibbs (12), rations high in grain and low in roughage depressed the numbers of rumen microorganisms which were characteristically associated with relatively high roughage ingestion. Two calves (5 and 6) from the inoculated group were used to test the effect of heavy grain feeding on subsequent hay digestion.

Calf 5 was placed on a ration of one part alfalfa hay and two parts of a commercial pelleted calf starter for 7 days. After the seventh day, during which time 6.7 lb. of starter and 5.0 lb. of hay were eaten, a rumen sample was collected and microscopic examinations revealed that some of the characteristic rumen indicator microorganisms still were present. Hay then was removed from the ration, and the calf was allowed commercial calf starter pellets *ad libitum*. After 1 wk. the calf was found to be free of protozoa and other characteristic rumen microorganisms. At this time, the rumen microflora appeared similar to that usually seen in very young calves and may be compared to an uninoculated calf which had eaten negligible amounts of hay. The ration then was changed to alfalfa hay *ad libitum* in a period of 3 days. A 7-day preliminary period was followed by a digestion trial of equal duration. Microscopic examination of rumen samples revealed that the calf was held free from protozoa and certain indicator hay flora throughout the trial, during which time the calf was isolated to prevent contact with other animals.

Calf 6 was fed 9.7 lb. of the regular herd milking ration (a simple, 14.5 per cent protein mixture of corn, oats, soybean oil meal, bran and salt) and 5.0 lb. of alfalfa hay during a 7-day period, followed by a 7-day period on the simple

grain mixture *ad libitum;* however, examination showed the rumen was not freed of protozoa and hay flora. Since the commercial calf starter had been used successfully in eliminating the protozoa and hay flora from calf 5, it was fed *ad libitum* for 4 days to calf 6. This calf's rumen then was observed to be free of the indicator microorganisms. After 3 days for changing over to alfalfa hay *ad libitum,* a 7-day preliminary and a 7-day collection period followed. However, a rumen sample obtained at the conclusion of the preliminary period revealed that in calf 6, protozoa and hay flora had reappeared. This may have been due to the lack of complete isolation from an inoculated calf in the adjoining pen separated only by iron pipes 4 in. apart, or to incomplete removal of the indicator microorganisms.

RESULTS AND DISCUSSION

The influence of rumen inoculations on the digestibility of dry matter, cellulose and protein in calves fed various kinds and amounts of roughage is shown in tables 1 and 2. Inoculated calves (group II) digested a higher percentage of cellulose than the uninoculated controls (group I) during the first and second digestion trials. When the data of these two 7-day trials were combined and treated as one 14-day digestion trial, the differences in digestibility of both cellulose and dry matter were found to be statistically significant (table 1). Thus, rumen inoculations appear to increase digestion of roughage in calves at an early age. However, it is considered to be significant that the increase in digestibility attributed to rumen inoculations during the first two trials was not found in later trials after the calves were taken off milk and were consuming larger amounts of roughage (table 2). This may be explained at least partially on the basis that a substitute microflora, which was able to do a creditable job of cellulose digestion, may have become established in the rumens of calves which were segregated from the natural source of inoculum. The indicator method used was not adequate to measure this possibility.

Since it is known that the digestibility of milk is different from alfalfa hay, a factor which may have affected the percentage of protein and dry matter digested during the first two trials was the constant level of milk consumed for all calves with a variable intake of hay from individual to individual. The calves of group I (uninoculated) had a higher level of hay consumption during the experimental period, since they were at an average older age when placed on trial. The average age at which the daily hay consumption of the calves was sufficiently consistent to begin digestion trials was 8 days earlier for the inoculated calves than for the uninoculated calves.

There are no significant differences in the apparent digestibility of protein by calves with and without characteristic rumen microorganisms. The occurrence of small differences between the inoculated and uninoculated groups indicates that, although the characteristic rumen microorganisms may be involved in the protein digestion, they have little influence on the apparent absorption of protein by the calf. It is interesting to note, however, that the average apparent digestibility of protein differed by approximately 2 per cent in favor of the in-

TABLE 1

A comparison of the digestibility of dry matter, cellulose and protein in cud-inoculated and uninoculated calves on a ration of alfalfa hay and milk

Calf no.	Dry matter		Cellulose		Protein	
	Intake	Digested	Intake	Digested	Intake	Digested
	(*g.*)	(%)	(*g.*)	(%)	(*g.*)	(%)
	First trial (Calves fed alfalfa hay and milk)					
	Uninoculated (group I)					
0	3923	80.47	544.4	59.87	812.6	81.45
1	4651	76.47	811.0	62.83	905.8	74.73
2	2817	83.96	243.0	70.56	516.8	82.84
4	3458	82.00	367.2	53.00	695.7	80.81
8	5112	76.64	688.1	57.61	1086.2	78.83
Mean	3992	79.90	530.7	60.78	803.4	79.73
	Inoculated (group II)					
3	3021	83.96	381.2	65.30	665.0	83.44
5	2685	87.99	245.6	69.81	549.1	84.30
6	2964	80.83	380.6	64.81	578.6	76.88
7	2981	85.88	321.6	65.98	641.2	82.36
9	4186	83.80	531.9	68.54	838.1	82.73
Mean	3167	84.49	372.1	66.90	654.4	81.94
Diff.		4.59		6.12		2.21
	Second trial (Calves fed alfalfa hay and milk)					
	Uninoculated (group I)					
0	4583	76.05	802.0	63.18	867.2	77.56
1	5688	75.04	1051.5	63.21	1120.3	75.16
2	3702	79.89	553.2	58.51	741.1	81.23
4	4344	78.87	704.0	58.22	864.8	80.71
8	5883	73.96	1056.6	63.75	1267.2	79.08
Mean	4850	76.76	834.6	61.34	972.1	78.70
	Inoculated (group II)					
3	4085	81.51	702.7	66.43	799.2	81.92
5	4046	80.90	618.0	63.72	801.3	81.48
6	4394	80.61	704.4	60.61	874.7	81.76
7	4421	81.41	800.7	70.75	904.7	82.23
9	5216	79.29	972.6	66.92	888.4	77.07
Mean	4432	80.76	759.6	65.76	853.2	80.99
Diff.		4.00		4.42		2.29
Summary[a] (trials 1 and 2 combined)						
Group I		78.45		61.24		79.04
Group II		82.29		66.05		81.48
Diff.		3.84*		4.81*		2.44

[a] The data were treated statistically according to the procedure outlined by Snedecor (14).
* Significant at the 5% level.

oculated group in each series of digestion trials. This may have been due to the digestion of protozoa from the rumen and substantiates the evidence of Ferber and Winogradow-Fedorowa (4) who, by estimating the total rumen population and estimating the rate at which protozoa disappear from the rumen, cal-

culated that approximately 2 per cent of the total protein digested daily was furnished in the form of rumen protozoa protoplasm.

As shown in table 3, pronounced decreases in efficiency of digestion followed when a calf's rumen was freed by heavy grain feeding of protozoa and certain bacteria which are associated with a high proportion of hay consumption in relation to grain concentrates. One calf which was held free of characteristic microorganisms after hay feeding was resumed utilized approximately

TABLE 2

A comparison of the digestibility of dry matter, cellulose and protein in cud-inoculated and uninoculated calves on rations of alfalfa hay or pasture

Calf no.	Dry matter		Cellulose		Protein	
	Intake	Digested	Intake	Digested	Intake	Digested
	(*g.*)	(%)	(*g.*)	(%)	(*g.*)	(%)
			ALFALFA HAY			
			Uninoculated			
0	3661	61.09	1135	63.10	617	61.86
1	6287	63.01	1736	61.30	1214	71.53
4	7062	63.59	2032	66.30	1407	69.22
Mean	5670	62.56	1634	63.60	1079	67.54
			Inoculated			
3	4691	64.32	1318	62.82	869	69.78
7	5060	63.24	1478	65.61	1201	74.08
9	4358	69.64	1005	60.88	536	67.66
Mean	4703	65.73	1267	63.10	869	70.50
Diff.		3.17		−.50		2.96
			PASTURE GRASS			
			Uninoculated			
1	7367	71.48	2052	81.78	1493	72.52
2	4632	73.46	1260	82.90	1083	74.65
Mean	6000	72.47	1656	82.34	1288	73.58
			Inoculated			
3	5422	71.78	1473	82.21	1266	75.22
7	7021	71.74	1879	79.36	1532	76.04
Mean	6222	71.76	1676	80.79	1399	75.63
Diff.		−.71		−1.55		2.05

17 per cent less of the available cellulose, 12 per cent less dry matter and 5 per cent less protein in a 7-day trial than did a similarly treated calf 6, in which the characteristic rumen microorganisms reappeared after hay feeding was begun.

Thus, grain concentrates fed *ad libitum* to calves in the form of a commercial calf starter pellets proved to be an effective means of freeing the calf's rumen of protozoa and certain characteristic rumen microorganisms which are associated with hay ingestion. However, a simple, 14.5 per cent protein grain mixture (corn, oats, bran, soybean oil meal and salt) did not completely free

the rumen of calf 6 from the characteristic rumen microorganism in a 7-day period. Perhaps the desired result would have occurred if the grain feeding had been prolonged.

SUMMARY AND CONCLUSIONS

A series of balance trials were conducted to determine if calves inoculated with cud material from older cattle and fed rations high in roughage would be able to digest dry matter, cellulose and protein more efficiently than would calves similarly fed but uninoculated.

Five inoculated and five uninoculated Jersey calves first were fed for 14 days on a ration of limited whole milk and alfalfa hay *ad libitum*. During this period, the calves which were inoculated digested a statistically significant higher percentage of the cellulose and dry matter ingested than the calves which were uninoculated. However, this appreciable difference in digestibility between inoculated and uninoculated calves disappeared when some of these calves were later placed on rations of either alfalfa hay or grass clippings only.

TABLE 3

The effect of the removal of characteristic rumen microorganisms by heavy grain feeding on the digestibility of dry matter, cellulose and protein in calves fed alfalfa hay

Calf no.	Dry matter		Cellulose		Protein	
	Intake	Digested	Intake	Digested	Intake	Digested
	(*g.*)	(%)	(*g.*)	(%)	(*g.*)	(%)
6[a]	7128	66.59	1727	64.76	1436	71.63
5[b]	6504	58.06	1656	53.50	1293	67.42
Difference		8.53		11.26		4.21
% Difference		12.8		17.4		5.9

[a] Rumen freed of characteristic microorganisms which reappeared before the digestion trial began.

[b] Rumen freed of characteristic microorganisms and remained free through the digestion trial.

No statistically significant differences were noted in the apparent digestibility of protein between inoculated and uninoculated calves on any of the rations used. The small, though consistent, difference in protein digestibility of approximately 2 per cent in favor of the inoculated group in each series of trials may be attributed to the digestion of protozoa protoplasm.

A calf freed of all or almost all of the characteristic indicator rumen microorganisms by heavy grain feeding, when placed on a ration of alfalfa hay, showed a marked decrease in digestibility of cellulose in comparison with a similarly treated calf in which the characteristic rumen microorganisms reappeared, possibly due to natural reinoculation.

These results are interpreted to mean that when roughage constitutes the entire dry feed, cud inoculations aided in providing microorganisms which digested cellulose somewhat more efficiently than did microorganisms which became established in the uninoculated calves. The inoculations were observed

to stimulate hay consumption at an earlier age than when no inoculations were given.

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CONCENTRATED BUTTERMILK IN ICE CREAM[1]

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In 1949, 2.4 billion lb. of buttermilk containing more than 200 million lb. of milk solids were produced in the United States from the churning of cream. Probably three-fourths of this amount was sour-cream buttermilk, which was utilized as animal feed. Usually only sweet-cream buttermilk is of a quality which makes it acceptable in human food. The object of this investigation was to find some means of increasing and improving the utilization of sweet-cream buttermilk in ice cream.

The use of buttermilk as an optional dairy ingredient is considered one of the controversial points in the proposed Federal Standards of Identity for ice cream and frozen desserts (10). The authors demonstrated that buttermilk does contribute to improvement in whipping ability and flavor of certain ice creams. Whitaker (16) and Josephson and Dahle (6) showed that the inclusion of buttermilk solids in mixes containing butter improved the whipping properties of the mix. The improvement was attributed to the lecithin fraction of the cream. Thurston and Barnhart (14) observed a richer flavor in ice cream containing buttermilk, which they considered was due to the lecithin. The lecithin content of buttermilk has been reported to be four or five times greater than that of the milk from which it is derived (11).

Thomas and Combs (13) demonstrated the use of roller-dried, sweet-cream buttermilk in ice cream and concluded that the whipping rate was greater and the fresh ice cream was drier in appearance than when skimmilk was used. Also, they found an added richness of flavor imparted to the ice cream by the buttermilk. Others (1, 9) have called attention to the potentialities of buttermilk solids for ice cream.

Brown and Janzen (2) prepared skimmilk and buttermilk mixtures in the Vacreator. They concluded that the Vacreator-produced buttermilk concentrates improved the whipping quality of the mix and that they were preferable to dried skimmilk for use in ice cream.

Combs (3), in experimenting with roller-dried milks, reported making ice cream of excellent quality using sweet-cream buttermilk as a source of milk-solids-not-fat.

During a study of buttermilk derived from centralizer sour cream, Tracy (15) found that the maximum quantity of solids from condensed buttermilk (acidity 1.05 per cent) that could be used without producing a noticeable effect upon the flavor of ice cream was approximately 1.6 per cent.

Sweetened condensed buttermilk has been mentioned as a suitable ingredient

Received for publication April 15, 1950.
[1] This work was done with funds provided by the Research and Marketing Act of 1946.

of chocolate coating (12), but its use in ice cream does not appear to have been investigated previously.

EXPERIMENTAL PROCEDURE AND RESULTS

Sweetened condensed buttermilk was prepared by following the procedure used in the manufacture of sweetened condensed milk. Cane sugar, at the rate of 12.5 to 13.5 lb. per 100 lb. of buttermilk, was added to an equal weight of water, the solution boiled, filtered and drawn into the vacuum pan following the

TABLE 1

The composition of fluid and concentrated buttermilk products used

Product	Milk-solids-not-fat	Fat	Sugar	Total solids
	(%)	(%)	(%)	(%)
Buttermilk	8.97	0.40	.....	9.37
Condensed buttermilk	26.80	0.90	.....	27.70
Sweetened condensed buttermilk	30.78	1.30	42.68	74.76
Spray-dried buttermilk	91.40	4.60	.....	96.00

buttermilk. This mixture then was concentrated to between 72 and 74 per cent total solids, cooled to 86° F., seeded with lactose and cooled with further agitation to 68° F., after which it was stored at a temperature below 60° F. for later use. Plain condensed buttermilk was made by concentrating fresh buttermilk in a vacuum pan to between 27 and 30 per cent total solids. The data in table 1 show the composition of these buttermilk products and of a sample of commercial spray-dried buttermilk.

Attempts were made to use buttermilk from neutralized sour cream. Several

TABLE 2

The effect of neutralization of sour cream on the flavor of ice cream containing buttermilk derived from the neutralized cream

Titratable acidity		Type of neutralizer	Flavor of ice cream
Raw cream	Neutralized cream		
(%)	(%)		
0.19	.....	Not neutralized	Good
0.25	0.12	Lime hydrate	Lacked fine flavor
0.30	0.21	Sodium bicarbonate	Slightly neutralized
0.30	0.23	Lime hydrate	Strongly neutralized, unpalatable
0.40	0.20	Lime hydrate	Strongly neutralized, unpalatable

lots of raw 20-per cent cream were allowed to sour at 72° F. until various percentages of titratable acidity were reached. The acidity of each lot of sour cream was adjusted by use of either lime hydrate or sodium bicarbonate as shown in table 2, and the cream was pasteurized by holding at 150° F. for 30 min. After churning, the resulting buttermilk was concentrated as described previously. In a second trial with neutralized buttermilk, fresh 20 per cent cream was churned and the buttermilk was divided into five lots which were allowed to develop five different degrees of titratable acidity ranging between 0.25

and 0.50 per cent. These lots of buttermilk then were neutralized, pasteurized and concentrated to between 25 and 35 per cent total solids.

The sweetened condensed buttermilk was used in making ice cream mix in the same manner as is sweetened condensed skimmilk, which it resembles in both appearance and composition. Sweetened condensed buttermilk furnished all but approximately 2 per cent of the milk-solids-not-fat in the experimental mix. In the case of plain condensed buttermilk prepared from neutralized sour cream, only one-half of the milk-solids-not-fat of the mix, excluding that supplied by the cream, was replaced with buttermilk solids.

The composition of the mixes was 12 per cent fat, 10 per cent milk-solids-not-fat, 15 per cent sugar and 0.25 per cent stabilizer. The materials used were 40 per cent cream, concentrated buttermilk (either plain or sweetened)

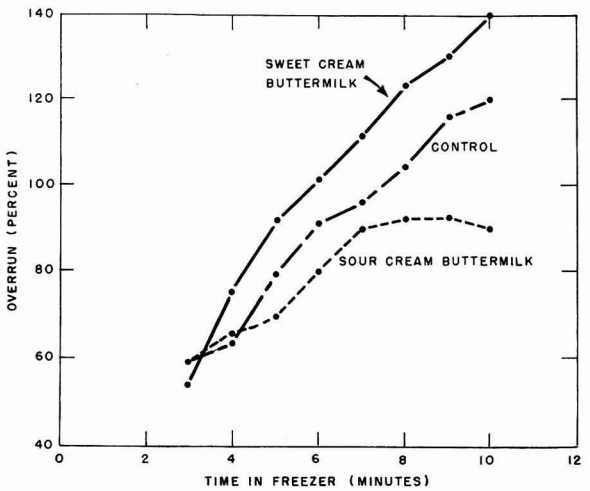

FIG. 1. Comparison of whipping data of mixes containing buttermilk solids from sweet and sour cream with a normal control mix.

and, where needed, plain condensed skimmilk. The small amount of solids-not-fat supplied by the 40 per cent cream was the same in all mixes. Each mix was pasteurized at 160° F. for 30 min., homogenized at 2,500 lb. pressure, cooled to 40° F. and aged 20 hr. During freezing, overrun measurements were taken at 60-sec. intervals, and pint samples of ice cream were drawn from the freezer at 90 per cent overrun. The overrun measurements were used as an index of the whipping ability of the mix (8, 9) and are illustrated in figure 1. Ice cream samples were stored at −10° F. for observation.

Studies were made of the keeping quality of sweetened condensed buttermilk. After storage for 6 mo. at 34° F. there was a slight darkening in color and age-thickening, but the product poured readily and dispersed in the mixing vat satisfactorily. Darkening and age-thickening occurred at 60° F. and these

changes took place more rapidly at 86° F. Figure 2 shows the rate of thickening of a sweetened condensed skimmilk during storage at 86 and 60° F. The data indicate that there probably is little difference between the rates of age-thickening of sweetened condensed milks made from skimmilk and from sweet buttermilk. For best results in retarding age-thickening and for protection against yeasts and spoilage organisms that tolerate sugar, sweetened condensed buttermilk should be manufactured in accordance with the accepted procedures used for sweetened condensed skimmilk. Sweet buttermilk (acidity less than 0.20 per cent) is forwarmed at 180° F. for 10 min., concentrated

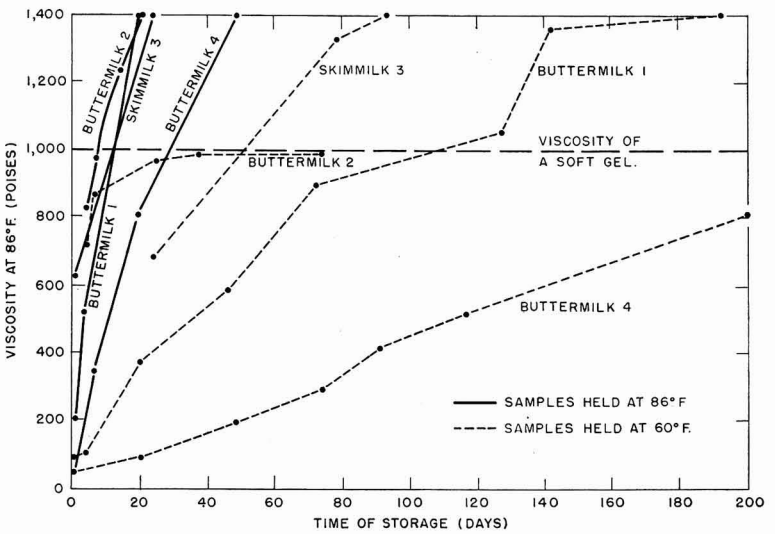

FIG. 2. The effect of storage on the viscosity of sweetened condensed buttermilk and skim milk held at 60 and 86° F. (1) Buttermilk: Acidity 0.16%; preheated at 180° F. for 10 min.; 12.5 lb. sugar added/100 lb. buttermilk; total solids 73.9%. (2) Neutralized sour cream buttermilk: Cream acidity before neutralizing 0.81%; buttermilk acidity at time of concentrating 0.18%; preheated at 162° F. for 15 sec.; 13.5 lb. sugar added/100 lb. buttermilk; total solids 65.73%. (3) Skim milk: Acidity 0.17%; preheated at 180° F. for 10 min.; 12.5 lb. sugar added/100 lb. skim milk; total solids 71.44%. (4) Buttermilk: Acidity 0.17%; preheated at 145° F. for 30 min.; 13 lb. sugar added/100 lb. buttermilk; total solids 74.76%.

with the addition of sugar to give a final sugar-in-water concentration of 62 per cent $\left(\frac{\text{per cent sugar}}{\text{per cent sugar} + \text{per cent water}} \times 100\right)$, cooled to and stored at 60° F. Solids from plain condensed, sweetened condensed and spray-dried buttermilk, when derived from cream of good quality, produced satisfactory ice cream in concentrations as high as 8 per cent of the mix. By contrast, ice cream in which the sweet-cream buttermilk was replaced by buttermilk solids from cream that had developed more than 0.25 per cent titratable acidity was not palatable. Ice cream was made in which one-half of the normal milk-solids-not-fat was

replaced with buttermilk from cream that had first developed 0.30 per cent titratable acidity. Objectionable off-flavors were distinct and the ice cream was judged unsatisfactory.

A further disadvantage of the neutralized buttermilk was the excessive viscosity which developed in the unsweetened condensed product on the surface cooler. This characteristic, together with undesirable off-flavors, carried over into the mixes and made the utilization of neutralized-cream buttermilk in ice cream commercially impractical. Furthermore, the improved whipping properties observed in mixes containing sweet-buttermilk solids were not obtained when the solids were derived from neutralized sour-cream buttermilk.

Data collected during freezing of the buttermilk mixes in a direct-expansion batch freezer indicate that sweet-cream buttermilk solids increase the whipping abiliy of the mix. Figure 1 compares the whipping data of a control mix with that of two buttermilk mixes. In this comparison the overrun in the buttermilk ice cream reached 140 per cent in 10 min. and remained there for 15 min. The control mix whipped more slowly and did not reach as high an overrun. The sour buttermilk seriously impaired the whipping ability of the mix.

When mixes containing buttermilk solids were frozen in a continuous freezer, lower air gauge readings were required to obtain the desired overrun than when the control mix, without buttermilk solids, was frozen in the same machine. This is in accordance with the whipping results obtained previously with those mixes on a batch freezer.

Members of a tasting panel reported that the ice cream made with sweet-cream buttermilk had a richer or "creamier" flavor than the control, and, in limited preference tests, the buttermilk ice cream was preferred. The only perceptible difference between the buttermilk ice cream and the control which contained no buttermilk was the sensation of pronounced creaminess produced by the former. Buttermilk ice cream remained satisfactory during storage at $-10°$ F. for 4 mo. Sweetened condensed buttermilk which had been held below 60° F. for about 6 mo. was suitable for use in the manufacture of good quality ice cream.

SUMMARY AND CONCLUSIONS

Buttermilk solids can be preserved in the form of sweetened condensed buttermilk. This product may be stored for periods up to 90 days at 60° F. or at lower temperatures for longer periods without objectionable age-thickening developing.

Only buttermilk of good quality from sweet cream can be used in preparing buttermilk concentrates for ice cream. Buttermilk from unneutralized cream having a titratable acidity at the time of churning in excess of 0.25 per cent is unsuitable for use in ice cream. Buttermilk of unknown history should be examined carefully for off-flavor and excess titratable acidity before it is used in the manufacture of ice cream.

Buttermilk solids from sweet-cream buttermilk are an excellent source of solids-not-fat for ice cream. They are interchangeable with skimmilk solids and may be blended with skimmilk solids to improve the whipping properties

of the mix. Buttermilk solids impart a creaminess to the ice cream not ordinarily obtained with milk solids from more usual sources.

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FORTY-FIFTH ANNUAL MEETING OF THE AMERICAN DAIRY SCIENCE ASSOCIATION

P. R. ELLSWORTH, *Secretary-Treasurer*

The American Dairy Science Association assembled in Bailey Hall at Cornell University, Ithaca, N. Y. on June 20th, 1950, at 10:00 a.m. K. L. Turk, local chairman, introduced W. I. Myers, Dean, College of Agriculture, Cornell University, who gave the address of welcome. G. M. Trout, ADSA president, was introduced.

THE PRESIDENT'S MESSAGE

Mr. Chairman, distinguished guests, members of the American Dairy Science Association and visitors:

Thank you, Dean Myers, for those fine words of welcome to the Cornell Campus. Generous as they were, they are excelled by the numerous gestures of hospitality already manifested here amidst these beautiful surroundings. In the brief time we have been in Ithaca, we have noted with appreciation the planning of the various Cornell committees to make us feel at home and to assure us a successful meeting. The large attendance here this morning at the opening session of the 45th annual meeting of the American Dairy Science Association bespeaks the importance of the dairy industry in the nation's agriculture as well as the interest of the Association's members in Cornell University.

As president of the American Dairy Science Association it is my duty to report to you today upon the state of our Association and upon some related matters which I trust shall be of mutual interest.

For the benefit of our younger members, who may not be too familiar with the organization and management of the Association, the constitution, published in the Journal of Dairy Science, **26:** 788–792, 1943, provides that the business of the American Dairy Science Association shall be directed largely by an elective, short-term, rotating Executive Board. The Executive Board consists of the President, Vice-President, R. B. Becker, Florida; Secretary-Treasurer, P. R. Ellsworth, Ohio; and seven Directors, one of whom is the retiring president. The present Directors are: F. J. Arnold, Iowa; P. R. Elliker, Oegon; H. B. Henderson, Georgia; J. H. Hilton, North Carolina; P. F. Sharp, California; C. W. Turner, Missouri; and W. E. Petersen, Minnesota. In addition, details of the Journal are looked after by the Editor, F. E. Nelson, who is also *ex-officio* member of the Executive Board, and associate editors and by the Journal Management Committee responsible to the Executive Board. Many other committees render basic, labor-of-love work for the organization or its sections. Any action taken by the Production, Manufacturing or Extension Sections must be passed on favorably by the Executive Board before the action truly represents the official position of the American Dairy Science Association.

For several years the subject matter of the program of our annual meeting has been assigned to three general-interest groups: the Extension, Production and Manufacturing Sections. At one time an economics section existed, but was short lived. Considerable interest has been manifest during the past year in the reestablishment of such a section. The feasibility of creating an economic section should not be treated lightly, for it is becoming more evident daily that marketing is a vital phase of our industry and worthy of more attention from our members. Our host institution, Cornell University, is one of the institutions which has given much attention to dairy marketing and has made notable contributions along this line.

G. MALCOLM TROUT

Considering the size of the industry and its relationship to agriculture, the membership of our Association is not large, numbering slightly above 1700 plus approximately 850 student affiliates. In addition, the Journal is mailed to about 1200 subscribers. These figures for 1950 compare favorably with those of 1948 and 1949. The financial picture is healthy but not as gratifying as that of membership. Despite a marked increase in subscription price and a slight increase in membership dues last year it was necessary to dip into the reserve fund to keep operating. This could not continue. Thus, it will not come as a surprise to you to learn that the Executive Board in session yesterday, through necessity to keep the Association solvent, voted to raise membership dues to $8.00, effective January 1, 1951.

The Journal of Dairy Science is the window of our Association. The scientific world sees the American Dairy Science Association and its activities through the Journal. We are rated as the Journal is rated. It has been a source of pride to hear words of praise from our foreign dairy scientists about the Journal of Dairy Science and to know the esteem which they hold for our Association.

To the credit of the Association and to the editors themselves, there have been but four editors of the Journal in the 33 yr. of its existence, namely, Professor J. H. Frandsen, Dr. A. C. Dahlberg, Dr. T. S. Sutton and our present editor, Dr. F. E. Nelson. The Journal today reflects their abilities and efforts. But editors in themselves do not make journals. Their immediate task is that of editing—not writing. All the editing in the world will not produce a journal unless suitable, original material is submitted.

Many of our members belong to more than one technical organization each of which has a publication of its own that competes more or less with our Journal for original articles. Naturally, authors wish to publish their research conclusions where they will be read by the most people in that particular field of interest. Nevertheless, it must not be overlooked that the wide reader interest of our Association members in dairy nutrition, genetics, bacteriology, chemistry and biology with their applied fields make the Journal of Dairy Science a highly desirable one in which to publish scientific articles. We may be sure that when criticisms are heard to the effect that the Journal is late, that the articles are all production or all manufacturing, or that they cannot be understood, that the fault lies not with the editor or with the Journal Management Committee, but possibly with one of our members who failed to submit a well prepared, original manuscript, with someone who procrastinated in reading and returning a manuscript or galley proof, or with the reader himself.

Our Journal is more than a scientific journal carrying original articles. Thanks particularly to Dr. Hunziker for his foresight in 1935, it is in part an abstract journal describing briefly and documenting all useable literature pertaining to dairying found in new books, trade magazines and scientific journals throughout the world. Many of our members serve their Association through accepting the responsibility of abstracting certain publications. We need more abstractors in order to give the reader greater journal coverage. Herein lies an opportunity for a young dairy scientist, not only to serve his Association, but also to gain valuable personal benefits and training. Good abstracting takes time but brings compensation; the financial remuneration for such service is only the minor part.

The Journal of Dairy Science, and through it the dairy industry in general could profit by more good review articles. Herein lies a field in which a young dairy scientist might well distinguish himself. In preparing the review a word of caution seems necessary. May the reviewer be thorough and complete in surveying the literature on the subject undertaken so as not to pre-empt the field from another scholar who might have done the job more meritoriously. Many short specific reviews may be written. I cannot conceive of a research worker, or a teacher, either resident or extension, who after having served a few years of apprenticeship has not become obsessed with a certain field of work. In such fields a thorough review article could be written for the mutual interest and benefit of all.

The American Dairy Science Association was the outgrowth of "The Official Dairy Instructor's Association" founded in 1906. The science aspect of the name came as a result of a postcard vote of its members in 1917. While dairy instruction seems to have been the first concept, it was early recognized that good teaching involved knowledge based upon scientific data. Hence, the scientific aspect of the name of our Association came as a logical sequence. Without research, teachers have little to teach; without teachers, results of research are often buried or slow in being adopted. The teacher plays a very important role in dairying today. Through him the student gains his first concepts of the science of the industry and through him those engaged in dairying, production, processing and allied fields are appraised of the latest research. Thus, from the freshman level to the field of so-called adult education the teacher, both resident and extension, wields an influence difficult to measure.

Unfortunately, many of our dairy scientists

engaged in teaching and research look askance at teaching. To be a good teacher does not connote the same as to be a good research worker. To them teaching becomes merely a routine bread-and-butter job. The results of good, effective teaching cannot be measured by the same yardstick as research. Often, only after a lifetime does the role of the teacher manifest itself, whereas recognition comes relatively early in research. However, young dairy scientists cannot be criticized too severely for casting a wary eye toward research and writing to the neglect of effective teaching, since in that way often lies promotion, so long as many of us in college work continue to rate highly the attention-getting factor of research publications and erroneously accept the philosophy that almost anyone who can meet a class can teach.

Our dairy industry needs today as never before trained, versatile, enthusiatic, substantial teachers —teachers who love to teach; teachers who like people; teachers who thrill at the growth in mental stature of their students; teachers who "spark" students with truths that challenge their thinking; teachers who can perceive potential leadership in the freckle-faced, red-headed boy sitting in the front row or trying to conceal himself as far back as possible; teachers with conviction and sustained enthusiasm for their job. Emerson tells us that, "Nothing great was ever achieved without enthusiasm." Many in this audience this morning owe their leadership today to the "lift" given them by some one good teacher.

Perhaps not many dairy instructors may ever attain the eminence in teaching as did the late Benny Shambaugh of Iowa or Billy Phelps of Yale. Nevertheless, every dairy instructor ought to be able to say with Phelps:

> "I do not know that I could make entirely clear to an outsider the pleasure I have in teaching. I had rather earn my living by teaching than in any other way. In my mind, teaching is not merely a life-work, a profession, an occupation, a struggle: It is a passion. I love to teach. I love to teach as a painter loves to paint, as a musician loves to play, as a singer loves to sing, as a strong man rejoices to run a race. Teaching is an art— an art so great and so difficult to master that a man or a woman can spend a long life at it, without realizing much more than his limitations and mistakes, and his distance from the ideal."

Only by losing oneself in the development of a student may we ourselves develop into a "Mr. Chips." The beneficial influence of such a teacher in the field of dairy science is beyond price. Many of the younger members of our Association should aspire to become teachers. It is a noble profession. Henry Brooks Adams points out so challengely that, "A teacher affects eternity; he can never tell where his influence stops."

Probably the agricultural world will never know the full worth of dairy extension in this country. As a general rule extension programs have been attacked with a zeal not equalled by other workers. Extension workers have been quick to grasp new ideas and carry them into the field. No one can deny their position of influence and responsibility.

Yet we should consider today the type of dairy extension of tomorrow. This is one of the most perplexing problems with which dairy departments are faced. We have prided ourselves too long in the number of meetings attended, the number of miles driven, or the length of the annual report. Often we are busier than ever and accomplish less. With availability of color photography, flying classrooms, visual aid, sound recording, tabulation machines, radio and television it behooves the extension man to consider seriously how he may better accomplish his work. He may be assured that his clientele, the dairy farmer and processor, through the radio, press, drive-in theater and/or television will have had his interest aroused already in the new findings in dairy research and allied sciences. Therefore, it becomes more imperative today for the extension worker to plan time for studying the literature in order to keep abreast of his field.

Comparing or contrasting the dairy science terminology of 1934, when our Association last met at Cornell, and that of 1950 awakens us with a start to the realization that science marches on and that we must participate actively or be content to sit on the sidelines. The Journal records no mention in 1934, of any discussion or any concern whatsoever for aureomycin, DDT, penicillin, bacteriophage, estrogen, nordihydroguaiaretic acid, geniatrics, oxytocin, cobalt deficiency, diluters, thyroxine, *S. faecalis* starters, continuous buttermaking, ring testing, thyroprotein, B_{12}, activated flavor, unidentified lactation factors, rumen microbiology, bovine saliva, fast milking, wetting agents, A.P.F. (animal protein factor), quaternary ammonium compounds, yolk-citrate buffer, progesterone, sulfhydryls and/or artificial insemination. Today the effective dairy extension worker must have not only a general concept of such new developments in dairying and related fields of science, but he must be well versed in the research data of the subject of his specialty as well.

While D.H.I.A. records have accomplished their primary purpose in showing the dairyman production abilities of his various cows, they have not yet been analyzed to their fullest extent.

Tabulation of data on I.B.M. cards suggests many possibilities. In fact, Cornell University, our host institution, has taken the leadership in recognizing the possibility of these machines in gleaning further data to aid in greater efficiency of production. With widespread adoption of artificial insemination it becomes imperative to be able to forecast with high correlation the influence of selected sires on the progeny of cows in the mass. To this end, the geneticist with the I.B.M. card system will extend the arm of activity of the extension dairyman.

Our extension dairymen through the county agricultural agents should work more closely with the primary markets for milk and cream. Bias, based upon prejudice and misinformation, stifles progress in quality production. The oldtime idea that the milk plants and creamery managements all are prone to thrive on sharp practices, if not outright dishonesty, and are to be tolerated only because there is no other market should not exist. Carping criticism from or toward the producer or processor merely provides fuel for sensational journalism or unreasoning critics and is helpful to neither branch of our great industry. Let us work more closely with our markets, with the processor and distributor, learning of their problems also, keeping in mind always the ultimate goal of providing the consumer with a good wholesome product at the lowest possible price, commensurate with enabling both the milk producer and manufacturer to operate at a fair profit.

Let us take renewed interest in our dairy extension. It is a work of which we can justly be proud. The accomplishments reveal much: a well managed dairy farm; an efficient herd; a sustained economy; an improved product; a friendly spirit between producer and processor; a confident consumer; a conserved soil fertility; an inspired son; a contented rural family; an abundant living—the very foundations of American democracy.

Probably never before in the history of our Association have there been so many dairy scientists, such a multitude of problems and relatively so little research productivity. The masses of students following World War II required increased teaching staffs and greater teaching loads so that research suffered as a result. Teaching had to be done. As a consequence, research productivity in many of our institutions has been at an all-time low. This situation must be righted and soon. Problems are arising out of proportion to their solution.

Time does not permit the recounting of the major problems in the various branches of the dairy industry, even if we could. We are more concerned today with emphasizing to the young research worker the need of greater research activity and, figuratively speaking, to point out that the research of tomorrow will be started by the young man of today.

Pure versus applied research is not the question. One is void without the other; one appears to be as fundamental as the other; without the first, the second could not exist. Workers in pure research conceive heavy water; those in applied research make the hydrogen bomb. Pioneer research may be carried out in either field.

Scientific truths cannot be discovered without work, without hard work, without obsessive work. Pasteur once said that "chance favors the prepared mind." Fearing the accusation of being facetious, I would venture to add, nevertheless, that chance favors the prepared mind *if the mind is put to work*. Many of the great discoveries of the world were made while the worker was engaged in a phase of work almost unrelated to that for which the worker gained renown. But back of the discovery was an active worker. Pasteur discovered dextro- and levotartaric acid, yet his name goes down through the ages associated with bacteriology; Babcock observed metabolic water, yet the world beat a pathway to his door for introducing a relatively simple fat test; Fleming was counting bacteria and gave to the world penicillin; government scientists set out to find a residueless substitute for arsenical sprays for Washington apples and found instead the long-sought cure for nodular disease in Ohio sheep.

These illustrations may seem far fetched, but I do want to emphasize that which every research worker here today knows so well, that a beginning in research must be made; that often in research the goal is never reached; that frequently the paths toward that goal are wandering and disheartening but eventually lead to some fascinating gems the presence of which neither could be predicted nor calculated; and that only by being actively engaged in research can the worker hope to gain that stimulus which enables him to plod on into those unexplored fields where only the active and persistent may hope to delve into Nature's secrets. I believe it was the late Dean Henry of Wisconsin who said, "Nature has always been a guardian of her secrets; they are wrested only by long, laborious, tedious processes."

In general, our remarks along this line represent views not facts. Darwin wrote, "False facts are highly injurious to the progress of science, for they often endure long; but false views if supported by some evidence, do little harm, for everyone takes a salutary pleasure in proving their falseness." Hence, calling these situations to your attention can do no harm; let us hope they may

do some good. The dairy industry is confronted today with many problems from which the American Dairy Science Association and its individual members cannot entirely wash their hands.

The dairy industry, both production and manufacturing, is demanding a different type of training of our college students than that given them in the past. In the future, more emphasis will be placed on fundamentals and less on applications. Teaching of products and cattle will be minimized. Instruction will include, in addition to the basic sciences, business administration, economics, labor relations, psychology and possibly foreign language. Short courses will provide instruction for those who are not qualified or who do not wish to take the basic, 4-yr. course. It behooves the American Dairy Science Association to make a thorough study again of the whole dairy curriculum, considering the short course, collegiate, and graduate levels. Our Association had two committees years ago that accomplished some benefits, but further work is needed now. This is not a job for one single institution but for specially appointed committees of our Association working closely with the industry.

The public relations of the dairy industry as a whole are poor. They must be improved and stabilized. The dairy industry loses friends rapidly when big city newspapers carry stories serially of producer-distributor price bickerings giving little consideration to the consumer. Squabbles over inspections, jangles between labor and management, and wranglings, turmoil and distorted facts by an uninformed press over restrictive legislation tend to undermine confidence in the minds of consumers toward dairy products. We may be certain that consumer goodwill will yield more profits to the industry than all the legislative barriers combined. Our Association cooperating with the national breed, product and allied associations could render a real service to the industry by feeding the press regularly popular, sound, dairy science news.

Packaging and merchandising of our products must keep pace with the times. Our Association has led in stressing sanitation and quality, but we all, industry included, have shied at costs associated with good merchandising. In many cases, the consumer has been forced to judge the product by its package—and the package often indicated a cheap product. Recently a check at two Michigan supermarkets revealed seven to eight brands of oleomargarine and one to three brands of butter on display. All the oleomargarine was attractively cartoned with the live yellow color predominating; whereas the butter, in general, was conspicuous by lack of cartons, by its wrinkled parchment wrapper, misshapen prints and an unwieldy 2-lb. roll. Beside the butter was 15-cent lard similarly packaged. Obviously, in an attempt to merchandise the butter economically, we overlooked eye appeal with the result that sales suffered. Let us remember that price is incidental when buyers yearn for the commodity whether it is butter or Buicks. An industry such as ours cannot survive by catering to nostalgia. The country roll and butter-crock days of merchandising are gone with the cracker barrel. But packaging alone will not suffice; the public must have ready access at all times to good quality products.

The industry will tend to shift from the fat standard. Our industry can no longer be tied to fat alone; each constituent of milk fits into the dairy economy. Non-fat dry milk solids are no more a by-product of milk than is fat or casein. Yet, our whole dairy economy has been built solely around fat and we are loathe to change, but change we must. The discoverer of an accurate, quick, simple total solids test for whole milk will be hailed as the Babcock of tomorrow, for more and more we are going to be concerned with the total solids of milk and not chiefly with fat alone.

Periodically, news releases acclaim some negative quality of whole milk or of its derivatives to the detriment of some branch of the industry. When one branch withers, the tree begins to die. Likewise, when one branch of our industry suffers, the whole industry is affected. Down through the ages the cow has always given whole milk—not a fat-free milk; through the years to come she will continue to do so. The positive qualities of butterfat or other milk constituents and of dairy products must be stressed repeatedly through sound, research-substantiated, regular news releases and attractive advertising. June Dairy Month advertising, beneficial as it is, remains a flash-in-the-pan type of advertising. Sound advertising must be maintained throughout the year. But let us keep in mind that all the advertising in the world will not move continuously inferior products.

The recurring surplus, or overproduction bugaboo can be knocked out. Surpluses are often mere illusions. They disappear quickly in the face of crop failures and of new uses for the product. Consider the citrus fruit industry. Only yesterday oranges growers were faced with surpluses. Creation of frozen, concentrated orange juice not only emancipated the housewife from the tedious job of squeezing oranges but created a shortage of orange groves the extent of which was beyond the wildest dreams of the orange growers themselves. Let us have high quality, basic butter, cheese,

beverage milk, ice cream, evaporated milk, sweetened condensed milk and so on, but may we as dairy scientists neither exclude the possibility of nor be blinded to the needs for special new food products that contain a relatively high content of dairy products. It becomes imperative, if dairy products are to maintain their relative position among the numerous food products found on the shelves and in the refrigerators of our colossal supermarkets, that research leading to the maintenance of quality and the creation of new dairy products be started at once. When such products retain the basic nutritional factors, appeal to the eye and palate, and are promoted intelligently, the looming surplus erroneously thought to be over-production will disappear quickly. We will not need to cry "Wolf" so loudly that Washington may come to the rescue.

The merits of non-fat dry milk solids today remain comparatively unappreciated. Consumers associate these solids with skimmilk, believing that the value portion of milk has been removed in the skimming process. Lactose retails at approximately 75 cents per pound; yet non-fat milk solids, containing 50 to 55 per cent lactose and 30 to 35 per cent of protein made up of the choicest of amino acids, sells for less than 15 cents wholesale. Non-fat dry milk solids might possibly be used more extensively in some existing dairy products and in new dairy products. For years the pediatrician has had prepared milk foods for his prescription; the geriatrician needs such a product badly.

The nutritionists within and without the American Dairy Science Association are to be commended on their researches and admonitions leading to the inclusion of dairy products in the diet. But we must realize that people drink milk and eat dairy products because they like them. Few are concerned with their teeth or health until they are gone. Let us quit giving lip service to quality but insist on palatability of product as well as safety and nutrition. Let us feed more roughages containing higher levels of those factors which tend to stabilize the good flavor of milk. Then may the milk and cream be produced sanitarily and adequately refrigerated so as to retain their original goodness.

Discussion of efficiency of production and management has become stale by repetition. For 50 years we have talked so much, worked so hard and accomplished so little in raising the level of fat production of the cows in the mass. In artificial insemination we have a scientific tool which, if properly employed, will have a marked influence on the level of fat production within a short space of time. But the dairyman must not rest upon the merits of superior germ plasm, upon the service of proven sires; that is only the beginning. As H. E. Babcock of Ithaca, N. Y., points out, the dairyman himself must be proved. He must know disease control, feeds and feeding and good dairy farm management if he is to get maximum, efficient production even out of superior progeny from mass artificial insemination.

Dairy plant managers are not without their problems. Efficiency, waste disposal, vitamin retention, procurement, processing and distribution problems, important as they are, pale in importance when compared with those of fitting plant operations to the changing conditions brought about by labor. In fact, the dairy processing industry appears to be heading into an industrial revolution. But it will emerge triumphant with more automatic machinery, stationary pipe lines, sealed equipment and continuous operations requiring less labor but that of a highly technically trained, skilled character. Six-day-a-week plant operation is foreseen as common. It is not to be excluded that in the not too distant future the large-city milk supply, as market milk and/or fresh 3 to 1 concentrate, may be processed where labor is not so competitive. As these inevitable major transitions are evolving, the producer-distributor relationships must be such that the changes occur with the least adverse publicity and without hardship to the consumer.

Not in the last half century has there been such a need as now for sound, unselfish, dairy leadership—for leadership that transcends partisan, personal and product lines; for leadership that truly dips into the future while anchored soundly in the present—in brief, a dairy statesman. The dairy industry needs statesmanship. What our industry would give today for a dairy statesman!

In conclusion, may I say briefly that we have a great Association. We all may look with pride at its accomplishments during the nearly half-century of its existence. It is fitting that the opening session of the 45th Annual Meeting of the American Dairy Science Association should be held in Bailey Hall which was named after that idolized patriarch of scientific American agriculture, Liberty Hyde Bailey. At 92 yr. of age, Dr. Bailey looks not backward at his enviable accomplishments in teaching, administration and research, but rather looks forward to the challenging problems and unfinished tasks of the future. Likewise, the members of the American Dairy Science Association and guests are gathered here today, tomorrow and Thursday not to gloat over our accomplishments, but to set our sights to the tasks ahead. We have come to learn of each other's research, to estimate techniques, to discuss the numerous problems and to reassure

ourselves so that we might be better equipped to teach, to investigate and to evaluate the situations which constantly arise in the great field of dairying. May this be a most successful meeting to all.

Chairman Turk then introduced Dr. E. E. Day, former President and Chancellor, Cornell University, as guest speaker. The opening session adjourned at the conclusion of Dr. Day's address.

BUSINESS MEETING OF THE AMERICAN DAIRY SCIENCE ASSOCIATION

Ithaca, New York, June 22, 1950

President Trout called the meeting to order at 3:00 p.m. in Room 25, Warren Hall. There were 225 members present.

REPORT OF THE EXTENSION SECTION

The first session of the Extension section of the 45th annual meeting of the American Dairy Science Association was called to order by Chairman C. W. Reaves of Florida, Tuesday, June 20, 1950, at 1:30 p.m. in Room 140, Warren Hall. Mr. Reaves welcomed the group and made brief comments in regard to the program.

The Chairman called upon Raymond Albrectsen, New York, to introduce the guest speaker, L. R. Simons, Director of Agricultural Extension, Cornell University, who spoke on the topic, "Effects of Extension in New York."

A short business session included further announcements and committee assignments. The nominating committee appointed included Floyd Arnold, Iowa; J. D. Burke, New York; and J. R. Parrish, Alabama.

Papers and demonstrations for integrated county meetings on dairy farm management and dairy subcommittee work in county agricultural planning program were presented and discussed.

Meeting adjourned to the exhibits in Room 101, Warren Hall. Nine exhibits from eight states were reviewed by personnel in charge from respective states. Twenty-two states also had on display bulletins, pamphlets, folders and other literature used as teaching aids in 4-H Dairy Calf Club work. John Foster, Kentucky, served as chairman of the Exhibits Committee.

Wednesday forenoon, June 21, Vice-Chairman Ray Albrectsen presided. The meeting was called to order at 8:50 a.m. in seminar room, fourth floor, Warren Hall. A symposium on D.H.I.A. organization, operation and record analysis by Dairy Records Committee was conducted by R. G. Connelly, Virginia. Wisconsin presented a paper on types of testing and T. Y. Tanable, Penn State, gave a fine review through the use of colored slides of his work on "The Nature of Reproductive Failures in Dairy Cattle."

A joint session of the production and extension sections was held in Bailey Hall at 1:30 to 5:00 p.m. on Wednesday. G. M. Cairns, Chairman, production section, presided for the symposium "Grassland Utilization and its Relation to Dairying." Four papers were presented. C. W. Reaves presided for the joint committee reports. These included:

1. *The Program of the Purebred Dairy Cattle Association.* Fred S. Idtse, Secretary, Purebred Dairy Cattle Association. Mr. Idtse gave an historical sketch from its beginning, reviewed its work, problems, policies, aims and achievements, all directed toward a sound constructive dairy herd improvement program.

2. *Breeds Relations Committee.* A. R. Porter, Chairman. Recommended desirable changes in the combined rules and regulations for official testing and registration of animals born as a result of artificial breeding.

3. *Dairy Cattle Health Committee.* No report.

4. *Dairy Cattle Breeding Committee.* Joe S. Taylor, Chairman, reporting, made the following recommendations: (a) New PDCA Rules and Regulations governing artificial breeding. (b) Advisability of encouraging active participation of artificial breeding leaders in American Dairy Science Association programs. (c) The wisdom of an additional service fee if offspring is to be registered was questioned. (d) The need for spelling out the ABC's of genetics for sire selection committees in artificial breeding. (e) Efficiency reports in artificial breeding.

5. *Type Committee.* W. S. Tyler, Secretary, reporting. Recommended program be continued. That respective colleges and universities cooperate with a long-time study in classification work with complete detailed information and classification of their dairy herds yearly.

All committee reports were approved by the joint session.

Thursday, June 22, Chairman Reaves called the meeting to order at 9:15 a.m. Papers were presented on 4-H Club work. Following discussions, the business session was opened by the Chairman.

Committee reports were read, discussed, amended and approved.

The Extension Dairyman Award Committee presented a plan for an Extension Dairyman Award which was approved for submission to the Executive Board of the American Dairy Science Association for action.

The nominating committee named two candidates for Secretary of the Extension Section for 1950–1951. Ivan Parkin of Pennsylvania was elected Secretary.

Chairman Reaves called the final session to order at 1:30 p.m. Papers pertaining to dairy cattle health were presented. The section then adjourned to the business meeting.

Respectfully submitted—RAMER D. LEIGHTON, *Secretary;* C. G. REAVES, *Chairman;* RAYMOND ALBRECTSEN.

Upon motion duly seconded, the report was accepted.

REPORT OF THE MANUFACTURING SECTION

The program for the Manufacturing section was carried out as scheduled and published in the May issue of the Journal of Dairy Science. A total 49 submitted papers were presented. Papers M8 and M46 were not given.

The business meetings of the sections were held Tuesday, June 20, at 4:30 p.m. and Wednesday, June 21, at 4:00 p.m., with approximately 75 members in attendance at each meeting. Chairman Josephson presided.

Reports of the following standing committees were read and accepted:

1. Milk and cream.
   Subcommittees
   (a) Standarization of the acidity test of all dairy products.
   (b) Standarization of the Babcock test.
2. Dairy by-products.
3. Butter.
4. Dairy product judging.
5. Milk proteins.

The section voted to continue the above committees.

The section voted approval of the amended recommendations of the standing committee on butter and approved the publication of the committee report in appropriate form, subject to approval by the Executive Board, in a suitable journal.

The section commended the Milk Industry Foundation for the plan which provides six annual Leadership Awards to outstanding dairy manufacturing students in the United States and Canada.

The following officers were elected to serve for the coming year: O. F. Garrett, Secretary; E. L. Jack, Vice-Chairman; and J. H. Hetrick, Chairman.

Respectively submitted—D. V. JOSEPHSON, *Chairman;* J. H. HETRICK, *Vice-Chairman;* E. L. JACK, *Secretary.*

Upon motion duly seconded, the report was accepted.

REPORT OF THE PRODUCTION SECTION

The Production section held four sessions for presentation of technical papers, at which 76 papers were presented. During each session, two sections were run concurrently, with Chairman G. M. Cairns and Vice-Chairman L. O. Gilmore presiding. The authors of the papers are to be commended for having their material well prepared and for keeping well within the prescribed limits in presenting it.

One joint session was held with the Extension section as a symposium on Grassland Utilization and its Relation to Dairying. G. M. Cairns presided.

This symposium was followed by a joint business meeting of the Production and Extension Sections, C. W. Reaves presiding.

The business meeting was called to order at 4:00 p.m., June 21, 1950.

Fred Idtse, Secretary of the Purebred Dairy Cattle Association, discussed the program of this association.

The following joint committee reports were read and acted upon:

Breeds Relations Committee report read by A. R. Porter, Chairman. Moved by Floyd Arnold, seconded by C. L. Blackman that the report be recommended to the Association for acceptance. Passed.

Breeding Committee report read by Joe S. Taylor, Chairman, who moved that it be recommended to the Association for adoption. Seconded by L. O. Gilmore. Passed.

Type Committee report read by W. J. Tyler who moved that it be recommended to the Association for acceptance. Seconded by L. O. Gilmore. Passed.

Dairy Cattle Health Committee. Chairman Joseph C. Nageotte stated that the committee had no formal report and asked for suggestions for developing next year's program by the committee.

The joint business meeting of the Production and Extension sections adjourned at 4:55 p.m.

The business meeting of the Production section was called to order at 11:00 a.m., June 22, 1950 by G. M. Cairns, Chairman.

I. W. Rupel presented the report of the nominating committee (E. Weaver, L. A. Moore). In keeping with the policy of recent years, they nominated L. O. Gilmore, present Vice-Chairman for Chairman and N. N. Allen, present secretary, for Vice-Chairman, and submitted names of P. A. Kelly and George Hyatt, Jr., for secretary. There were no further nominations. P. M. Reaves moved that the report of the nominating

committee be accepted and that the chairman and vice-chairman be elected by acclamation. Seconded by Fordyce Ely. Motion carried. As a result of a ballot, George Hyatt, Jr., was elected secretary of the Production section.

George Trimberger read the report of the Dairy Cattle Judging Committee, a copy of which is attached.

I. W. Rupel, commenting on the recommendation of admission of teams from two non-land grant schools to the National Collegiate Contests called attention to the large number of schools which offer work in agriculture and the difficulty of appraising their qualifications for participation.

L. L. Rusoff commented on the quality and scope of the dairy work at Southwestern Louisiana School of Agriculture and recommended their approval.

George Trimberger moved that the committee report be accepted and recommended for approval at the General Business Session. Seconded by L. L. Rusoff. Carried.

George Trimberger suggested that it be the policy of the committee to recommend admission or non-admission of any non-land grant schools with action by the Production Section rather than the committee. R. B. Becker and I. W. Rupel offered comments. Dwight Seath moved that admission of any non-land grant schools be decided by action of the Production Section upon recommendation of the Dairy Cattle Judging Committee. Seconded by Fordyce Ely. Motion carried.

J. B. Shepard presented a progress report for the Committee on Pasture Investigations Technique. He called attention to the fact that a final report required incorporation of reports from Pasture Investigation Committees of two cooperating organizations, which can probably be accomplished before the 1951 meetings. He moved that this be accepted as a progress report. C. W. Turner seconded his motion. Carried.

A. R. Porter called attention to the announced policy of the Purebred Dairy Cattle Association of inviting the Chairmen of the Production and Extension Sections, in addition to the Chairman of the Breed Relation and Dairy Cattle Breeding Committees, to participate in their annual meeting.

Meeting adjourned at 11:45 a.m.

Respectfully submitted—G. M. CAIRNS, *Chairman;* LESTER O. GILMORE, *Vice-Chairman;* N. N. ALLEN, *Secretary.*

Upon motion duly seconded, the report was accepted.

EDITOR'S REPORT

The 12 issues of Volume XXXII of the JOURNAL OF DAIRY SCIENCE printed during 1949 contained 870 pages of original articles, 84 pages of review articles, 8 pages of Association announcements, 17 pages of program for the annual meeting, 20 pages of proceedings of the annual meeting, 36 pages of abstracts of papers presented at the annual meeting, 51 pages of indices, 6 pages of table of contents, 39 pages of membership list, 186 pages of abstracts and 2 pages of miscellaneous. This makes a total of 1,327 pages, exclusive of the advertising sections and blank pages. This is an increase of 24 pages over 1948, but the actual increase in printed material is greater than that because 242 pages of material of a type not previously printed double column and in smaller type were so printed in 1949.

Of the 129 papers printed, 70 were on production subjects, 53 were on manufacturing subjects and 6 were reviews. This represents an increase of 27 manuscripts over 1948. Nineteen manuscripts were rejected during the year, a percentage which is just slightly above that of the past few years. Thirty-nine manuscripts were carried over from 1949 to 1950, many of them in various stages of preparation for printing; this is a reduction of 16 from 1948, indicating a somewhat more current basis of publication. Quite a few manuscripts have been delayed in publication by the slowness of certain authors in getting the manuscripts back to the editorial office following return to authors for a final check before the material went to the printers.

A total of 929 abstracts was printed in 1949, well over double the number printed in 1948 before the Abstracts of Literature Section was reorganized. The double-column organization and the use of a slightly smaller type size have permitted the printing of 113 per cent more abstracts with an increase of only 16 per cent in the number of pages. The type-setting per word costs are almost exactly the same with either form, but the press work, paper, binding and mailing costs are determined by the actual number of pages; thus, a considerable saving has been effected by the new form. Abstracts printed or in the hands of the printers for the first seven issues of 1950 number 550, a slight increase over last year at the same time.

The editor wishes to thank all of those who have assisted in any way in the handling of the affairs of the Journal. Only because of the splendid cooperation which is given by a large number of people is it possible even to publish the Journal, let alone maintain the standards set for the publication. Two men who have served

the Journal and the Association both long and well are retiring as Associate Editors this year; to Dr. O. F. Hunziker and Dr. C. A. Carey go the thanks of the Journal group and also of the Association. Dr. P. R. Elliker retires as a member of the Journal Management Committee; the Association is fortunate in that he will continue as a member of the editorial group.

As the report of the Secretary-Treasurer shows, the Association is spending more money than is being received, largely because of the current high costs of printing the Journal. Please bear with the reviewers and the editor when suggestions are made for the shortening of manuscripts or abstracts. Apparently, greater brevity of expression is going to be required if dissipation of the operating reserve which was accumulated over a period of years is to be stopped. The editor will do all that he can within the framework of the rules under which he must operate to avoid deficit spending.

Any member who could help by preparing abstracts from one or more journals not now covered in the Abstracts of Literature section is invited to contact the editor. The help of those who can prepare abstracts of papers appearing in foreign-language journals is especially desirable now that such publications are more available. If one or more persons in each institution would assume the responsibility of seeing that a copy of each bulletin or circular reached the editorial office so that a suitable abstract could be prepared, the coverage of dairy literature would be improved considerably.

Respectfully submitted—F. E. NELSON, *Editor*

Upon motion duly seconded, the report was accepted.

SECRETARY-TREASURER'S REPORT

MEMBERSHIP.

The following is a summary of our gains and losses for 1949.

Membership, December 31, 1948		1747
Gains:		
New members, 1949	139	
Former student affiliates	17	
Total gain	156	
Losses:		
Members resigned	10	
Members delinquent	163	
Members deceased	5	
Total loss	178	
Net membership loss		22
Membership, December 31, 1949		1725

This reduction in members is not desirable, but is present, nevertheless, and offers a real challenge to all members of the Association. If each member were to make a point of signing up a new member during 1950, this deficit could be erased and our membership nearly doubled. Letters written to prospective members by the secretary have netted a large percentage of favorable replies, but more names are needed if this system is to continue to function. Membership in 1949 exceeds the 1947 membership none the less.

CIRCULATION.

Circulation of the Journal for the year 1949 reached a total of 4,030 by the end of the year, an increase of 146 over 1948 circulation figures. The increased circulation is accounted for by subscribers and student affiliates.

STUDENT AFFILIATES.

The student affiliate picture is encouraging. The year 1949 saw an increase of 79 over 1948. Since the real purpose of student affiliate membership is to encourage students to assume full membership upon graduation, it becomes the duty of each department chairman to contact the graduating seniors relative to full membership. Letters sent out from the secretary's office to graduates whose names and addresses were furnished by some department chairmen resulted in a most favorable response. Over 50 per cent of those contacted paid 1950 dues for full membership. During 1949 the Virginia Polytechnic Institute Student Branch Certificate was renewed. At this date there are 21 student branches in the country.

FOREIGN CIRCULATION AND MEMBERSHIP.

Foreign circulation and membership continues to increase. At the present time our Journal goes to 45 foreign countries, reaching both subscribers and our newly acquired foreign members. England and Australia lead in this field with a total of 117 Journals. Several men of science residing in foreign countries have been accepted into membership through the provisions made at the 1949 annual meeting.

BONDS.

The foresight of the late R. B. Stoltz in purchasing Government Bonds in past years has started to pay off. During 1949 three $1,000.00 bonds matured and were redeemed. The money resulting therefrom was used to purchase four new $1,000.00 bonds which are now in the safety deposit box at the bank.

TEN-YEAR INDEX.

Work is nearing completion on the Ten-Year Index for the Journal and we hope to have it completed sometime during 1950 or early 1951. Mr. Macy, who is doing this work, is to be congratulated on his efforts and devotion to the job.

ASSOCIATION FINANCE.

During the year 1949 the Association operated at a $7,962.60 loss. This was expected, since the

die for 1949 was cast at the 1948 meeting where no increase in dues or subscription rates was authorized. With Journal costs constituting 74.7 per cent of the total and with membership dues still not large enough, a raise in dues for 1951 seems an absolute necessity. All other costs of the Association have remained approximately constant and constitute 25.3 per cent of the total.

I wish to take this opportunity to express my sincere thanks to all those members of the Association who have made the past year an interesting and enjoyable one for me through their willingness to work far above the call of duty for the Association's benefit and advancement.

Respectfully submitted—P. R. ELLSWORTH, *Secretary-Treasurer.*

Upon motion duly seconded, the report was accepted.

AUDITING COMMITTEE REPORT

June 8, 1950

To the Executive Board and Members of
The American Dairy Science Association
Gentlemen:

On June 8, 1950, Mr. Walter C. Burnham, a Certified Public Accountant, met with the Auditing Committee of the American Dairy Science Association. At that time, Mr. Burnham's report of his audit of the Association's business for 1949 was considered.

Mr. Burnham has made a thorough examination of the records. He has checked the bank statements and examined all the United States Government Bonds. Mr. Burnham has check-tested the inventory of Journals and Twenty-Year Index to assure accuracy of the physical inventory.

The Auditing Committee is satisfied that the financial statement for the year 1949 is correct. The committee wishes to commend Mr. Burnham, the auditor, for his fine work and excellent report. We recommend that the financial statement be accepted by the Executive Board and the members of the American Dairy Science Association.

Respectfully submitted—T. S. SUTTON; C. G. MCBRIDE; FLOYD JOHNSTON, *Chairman.*

Upon motion duly seconded, the report was accepted.

JOURNAL MANAGEMENT COMMITTEE REPORT

During the past year the Journal Management Committee has authorized the following action:

1. That the proposal of the Journal of Dairy Research for a reciprocal advertising arrangement between that publication and the Journal of Dairy Science be approved, provided our Secretary-Treasurer can arrange an equitable basis for exchange of advertising.

2. That the proposal of our Secretary-Treasurer to reduce the number of copies of the Journal of Dairy Science printed each month from the present 4,400 to 4,200 copies be approved. This proposal was prompted by the fact that the maximum number of Journals mailed out in any 1 mo. in 1949 was 4,028. The surplus of 372 copies, representing more than 9 per cent of total circulation, has created a serious storage problem, and is considerably in excess of anticipated future demand for the Journal.

3. That the Editor and the Secretary-Treasurer investigate the feasibility of incorporating a page in the Journal each month devoted to editorials, Association business, news items, or other items of general interest to Journal readers.

4. That in conformance with the established program for rotating associate editorships, C. A. Carey and O. F. Hunziker be retired, and L. A. Moore and F. J. Doan be appointed as Associate Editors.

5. That the present restriction whereby the Editor of the Journal is not authorized to accept manuscripts from non-members be recinded, with the provision that publication of such manuscripts be subject to approval by the Journal Management Committee.

The Journal Management Committee wishes to express the commendation of the Association membership to the Editor and the entire Editorial Staff for their continued untiring efforts and excellent accomplishments.

Respectfully submitted—P. R. ELLIKER, *Chairman;* G. H. WISE; J. K. LOOSLI.

Upon motion duly seconded, the report was accepted.

RESOLUTIONS COMMITTEE REPORT

WHEREAS! The Cornell University through its administrative staffs and faculty has made available to the American Dairy Science Association in this its 45th Annual Meeting all needed physical facilities for the meeting, and

WHEREAS: Every possible personal courtesy has been given to members of the Association for their enjoyment and entertainment,

Therefore, be it RESOLVED: That the American Dairy Science Association take this opportunity officially to extend its thanks and appreciation and hereby request the President of this Association to convey by letter this appreciation to Dr. C. W. de Kiewiet, acting president, and to Dr. E. E. Day, former president and chancellor, to Dean W. I. Myers and to Professors K. L. Turk and J. M. Sherman.

WHEREAS: Many commercial and civic organizations have contributed greatly to the success and enjoyment of this 45th annual meeting,

Therefore, be it RESOLVED: That the American Dairy Science Association express to these organizations its sincere appreciation.

WHEREAS: The Borden Company Foundation again has offered its awards for outstanding research in dairy manufacturing and production.

Therefore, be it RESOLVED: That the American Dairy Science Association express to the Borden Company Foundation its sincere appreciation of this evidence of its continued interest in dairy research.

WHEREAS: The American Feed Manufacturers Association has seen fit to offer an award for outstanding research in the field of dairy cattle nutrition.

Therefore, be it RESOLVED: That the American Dairy Science Association express to the American Feed Manufacturers Association its sincere appreciation for their interest in and encouragement of research in dairy cattle nutrition.

WHEREAS: The dairy industry is a most important segment of our agricultural economy and the dairy cow is an important means of converting farm crops into valuable human food, and

WHEREAS: The consumption of dairy products is not great enough to utilize all of the constituents of milk now being produced, and

WHEREAS: Milk and its products are highly nutritious and are needed in larger amounts in the average diet,

Therefore, be it RESOLVED: That the American Dairy Science Association call to the attention of research and educational workers and agencies, both public and private, these facts and urge on them intensified efforts to develop new and improved ways of using milk and the by-products of milk and to bring to the attention of consumers the high nutritional value and the economy of using more dairy products.

WHEREAS: Economic and marketing problems are becoming increasingly important in the production, processing and distribution of milk and its products, and

WHEREAS: These types of problems have not received the attention of this association that their importance justify,

Therefore, be it RESOLVED: That the Executive Board of the American Dairy Science Association consider making provisions for the presentation of material dealing with economic and marketing problems of the dairy industry.

WHEREAS: The rapid development of the dairy industry and the ever increasing expansion into new fields of production, manufacture and distribution calls for a highly trained specialized type of worker, and

WHEREAS: There is an immediate need to intensify and adopt the training of young people entering the dairy field to meet the problems of the industry.

Therefore, be it RESOLVED: That the Executive Board of the American Dairy Science Association appoint a committee to develop dairy curricula that will more completely meet present day needs.

Respectfully submitted—GLEN W. VERGERONT; R. E. HODGSON; H. O. HENDERSON, *Chairman.*

Upon motion duly seconded, the report was accepted.

NECROLOGY COMMITTEE REPORT

Your committee regrets to advise that during the current year the following members of the Association have been taken from our midst and have passed on to their final resting place:

Charles Sterling Trimble, Dairy Manufacturing Technologist for the Bureau of Dairy Industry, U. S. Department of Agriculture. He passed away in Washington, D.C., on February 21, 1950. He was born in Calhoun County, Iowa, on September 20, 1889. At the time of his death, he was in charge of the Bureau's regulatory work for the inspection of renovated or process butter. Mr. Trimble was graduated from Iowa State College in 1911. For the next few years he was employed in varied capacities in several mid-western creameries. He joined the dairy division of the Bureau of Animal Industry in 1917 as a dairy manufacturing specialist. He was a member of the Quartermaster Corps of the National Army from September, 1918, until December of the same year. In 1919, he resigned from the Department of Agriculture and became superintendent of a dairy plant in Seattle, Washington. Mr. Trimble returned to the Department in 1922, and remained there until his death. During these years, he investigated problems in buttermaking and creamery management, and supervised the manufacture of sweet-cream butter for the United States Navy. Concurrently he was in charge of the inspection of renovated butter factories. In addition to these duties, he introduced to commercial creameries the Bureau of Dairy Industry's method for manufacturing concentrated cultured buttermilk and the grain-curd method for manufacturing casein. After 1936, his primary duty was to administer the Federal regulatory acts relating to the enforcement of regulations governing the manufacture of process butter, and the inspection and certification of dairy products for export. He aided materially in the preparation of these Federal acts. He also cooperated quite closely with officials of the Bureau of Internal Revenue in their search for violations of Internal Revenue Laws relating to adulterated butter. Mr. Trimble was a prolific writer and speaker and

is the author of a complete but unpublished treatise pertaining to the history of the development of the factory system for manufacturing butter. He was a member of the Masons, the American Dairy Science Association and the Association of the Food and Drug Officials of the United States. He was a member of the Wallace Memorial United Presbyterian Church, in Washington since 1923 and was a trustee in this church for 18 yr. and an elder for 3 yr. He is survived by his wife, Mrs. Mary Berry Trimble and one daughter, Mary Patricia Trimble, who reside at 1443 Holly Street, N.W., Washington, D.C.

Dr. Oliver Ralph Overman, Professor of Dairy Chemistry at the University of Illinois, passed away Wednesday afternoon, November 23, 1949, at McKinley Hospital in Urbana. He was born in Windfall, Indiana, on April 15, 1886. Dr. Overman came to the University of Illinois in 1917 as Associate Dairy Chemist in the Department of Dairy Husbandry and, from his researches there, became known as one of the outstanding authorities in the United States on the chemical composition of milk. He received the baccalaureate degree from the University of Indiana in 1910, the Master of Science degree from that same institution in 1911, and the Doctor of Philosophy degree in Chemistry from Cornell University in 1917. Before coming to the University of Illinois, Dr. Overman taught at Indiana University, at Cornell University and was Professor of Chemistry and of Geology at Huron College, Huron, South Dakota. Professor Overman was head of the division of Dairy Chemistry in the Department of Dairy Science at the University, having been made an Assistant Professor in 1919, Associate Professor in 1935 and Professor in 1939. His principal scientific interests have been in the electrodeposition of lead, the oxidation of hydrazine and ammonia, and, especially, the chemical composition of dairy products, in which field he was a pioneer and in which he has made notable contributions to science and to the dairy industry. At the time of his death, Dr. Overman was just completing an extensive experiment in which he had been engaged for nearly 3 yr. It dealt with the effects of geographic distribution, season, climate and soil conditions upon the composition of milk produced by Brown Swiss cattle. Dr. Overman had been granted a sabbatical leave by the University for the second semester to study the various conditions in the United States where the milk was being produced and to complete his investigations. Perhaps the work for which Dr. Overman was best known was his detailed study of the energy value of milk, which information is included in most standard works throughout the world on the subject of the nutritive value of milk. He published the results of his extensive researches in many American, German, and French scientific journals, and was the author of a number of bulletins of the Illinois Agricultural Experiment Station. Dr. Overman was a member of a number of learned societies and scientific groups, including Sigma Xi, Gamma Sigma Delta, Alpha Chi Sigma, the American Dairy Science Association, and the American Chemical Society. He was a member of the Exchange Club of Urbana and had been active in Boy Scout work. He is survived by his wife, Mrs. Olive Spencer Overman of 610 W. Nevada St., Urbana, and two sons, Dr. Ralph S. Overman, a chemist in the Medical College of Cornell University, and Dr. Joseph D. Overman, also a chemist, employed by the DuPont Co. in Parlin, N. J.

Dr. Arthur Henry Kuhlman, Professor of Dairying at Oklahoma Agricultural and Mechanical College, Stillwater, Oklahoma, died at Stillwater on September 26, 1949. He was born January 1, 1886, at Lowell, Wis., a son of Fred and Anna Kuhlman. Dr. Kuhlman graduated from Juneau, Wis., High School in 1906. He receiver his B.S. degree in Animal Husbandry from the University of Wisconsin in June, 1910, and his Master's degree from the same institution in 1916. During the period of 1910–14 he was employed as part-time assistant in the Department of Animal Husbandry at the University of Wisconsin. He also held a temporary position as an instructor in Agriculture at Bemidji, Minn. From 1914–17 he was employed as Instructor in Animal Husbandry at the University of Wisconsin. During the year 1917–18 he acted as Emergency Demonstration Agent at Juneau, Wis. From 1918–26 he held the position of Associate Professor of Animal Husbandry at South Dakota State College, Brookings, S. D. He then returned to the University of Wisconsin for further graduate study and was granted the degree of Doctor of Philosophy in genetics in June, 1928. On January 1, 1929, he accepted a position with the Oklahoma Agricultural and Mechanical College as Associate Professor of Dairying. On July 1, 1929, he was raised to the rank of Professor in Dairying at Oklahoma Agricultural and Mechanical College, which position he held until the time of his death. From 1937–1939 he was Acting Head of the Department of Dairying at Oklahoma Agricultural and Mechanical College. Dr. Kuhlman is the author of over 60 scientific publications in the form of bulletins and journal articles. These include several on genetics, but his work dealt very largely with the nutrition of the various classes of livestock, particularly dairy cattle. He did a considerable amount of work on the nutritional value of cottonseed meal, mungbeans and mungbean, peanut and alfalfa hays, as well as several other feeds. More recently his research was confined to the

carotene requirements for growth and reproduction with different breeds of dairy cattle. His work also included several publications on the influence of various feeds on the chemical composition and physical characteristics of butterfat. At the time of his death, Dr. Kuhlman was a member of Alpha Zeta, Sigma Xi, Phi Sigma, Farmhouse, American Association for the Advancement of Science, American Society of Animal Production and American Dairy Science Association. Dr. Kuhlman also was very outstanding in Masonic work, being a member of Frontier Lodge #48 A. F. and A. M., Royal Arch Masons, Knights Templar, White Shrine, Eastern Star and Knights of the York Rites Cross of Honor. This last named order is conferred on only those members of the York Rites who have served as head of all York Rite Masonic bodies. Dr. Kuhlman made two trips abroad where he attended livestock shows and visited livestock farms in England, Scotland, Ireland, the Channel Islands, Holland, Belgium, Germany, Switzerland and France. Dr. Kuhlman was a man who was honored and respected by all who knew him. He was a true gentleman in every respect and played an important part in the life of his community.

Mark H. Keeney, Dairy Superintendent at Essex County Hospital, Cedar Grove, for 26 yrs., died October 9, 1949. Mr. Keeney was born in Denver, February 2, 1894. While a child he was taken to Laceyville, Penn., where he attended public schools. He was graduated from Pennsylvania State College, where he majored in dairying. He later received an M.A. from University of Missouri, which he attended on a scholarship awarded for judging cattle at the Chicago International Stock Show. When the United States entered World War I, Mr. Keeney was agricultural agent for Clinton County, Penn. He quit that post to join the Army. After the war he went to University of Missouri as a "dairy specialist." His health soon broke and he retired to spend a year farming in Ohio. In 1921 he came to Rutgers University as chief of dairy extension work, a post he held until going to handle the Essex herd. In the Spring of 1923 the Essex freeholders were considering disposing of the Overbrook Hospital dairy herd because of low milk yield and high cost of production. They decided first to apply to New Jersey College of Agriculture at Rutgers for an expert to make a survey. Mr. Keeney was sent. Within a few years the herd was setting world's records for milk and butterfat production and providing the hospital excellent milk at low cost. The production records soon brought unprecedented demands from dairymen for calves from the Overbrook herd. Many calves sold to owners of herds in Cuba, Puerto Rico and Central and South American countries. Mr. Keeney's reputation became international, particularly after publication of his *Cowphilosophy,* a handbook on how to develop highly productive dairy herds. The book, which is used as a textbook in numerous agricultural colleges, was a sequel to his *Bullphilosophy,* a short treatise on the breeding of bulls. In 1944 the Holstein-Friesian Association of America announced Mr. Keeney's herd had established a 10-yr. world's record for butterfat and milk production with herds of more than 70 cows. The Essex County Board of Agriculture in 1940 made Mr. Keeney an honorary life member. He had been a member since 1923 and served many years as its secretary. Mr. Keeney was a member of a number of societies and organizations, including Gamma Alpha, Lambda Gamma Delta, Acacia, Kiwanis Club, American Legion, American Farm Bureau, State Board of Agriculture of Pennsylvania and an honorary member of the Voorhees Society of Rutgers University. In 1941 the State Board of Agriculture presented Mr. Keeney its Distinguished Award. He was the youngest man ever to receive that honor. He is survived by his wife, Mrs. Eleanor McCullough Keeney; three sons Mark Keeney, Jr., a graduate student at Pennsylvania State College, where he will receive a doctorate of philosophy; David of Columbus, Ohio, and Philip of Winthrop, Minn., and two grandchildren.

S. S. Smith, Director of the Dairy and Food Division, Virginia Department of Agriculture, Richmond, died in December, 1949. He was graduated from Berry School, Mt. Berry, Ga. He operated an ice cream plant at Bristol, Va. and for a period of time he was instructor in dairy short courses at the Virginia Polytechnic Institute. In 1926 he joined the staff of the Virginia Dairy and Food Division as chief dairy inspector and a short time later he was made director of this division. In the loss of Mr. S. S. Smith, the dairy industry of Virginia lost a staunch friend and an untiring worker. His work in improving the standards of quality of the dairy products in the state stands as a monument to him.

Respectfully submitted—H. A. BENDIXEN; C. R. GEARHEART; W. H. E. REID, *Chairman.*

Upon motion duly seconded, the report was accepted.

REGISTRATION COMMITTEE REPORT

Frank V. Kosikowsky, Cornell University, made the following report for the Registration Committee:

Number of Persons Registering at A.D.S.A. Meetings, Cornell University, Ithaca, June, 1950.

State	*Total*
Alabama	9
Alaska	1
Arizona	2
Arkansas	2
California	8
Colorado	3
Connecticut	24
Delaware	4
D. C.	38
Florida	28
Georgia	12
Illinois	136
Indiana	21
Iowa	27
Kansas	11
Kentucky	32
Louisiana	4
Maine	5
Maryland	56
Massachusetts	36
Michigan	56
Minnesota	58
Mississippi	1
Missouri	17
Montana	3
Nebraska	7
New Hampshire	31
New Jersey	37
New York	346
No. Carolina	38
No. Dakota	2
Ohio	115
Oklahoma	3
Oregon	5
Pennsylvania	87
Rhode Island	11
So. Carolina	8
So. Dakota	4
Tennessee	10
Texas	6
Utah	5
Vermont	15
Virginia	45
Washington	8
West Virginia	17
Wisconsin	96
Wyoming	1
Total	1491

Other Countries

Country	*Total*
Alaska	1
Canada	27
Costa Rica	1
Denmark	4
England	1
Holland	3
Israel	1
Peru	1
Total	38
Grand total	1529

Men	940
Women	394
Children	195
Total	1529

MEETING OF THE EXECUTIVE BOARD

The Executive Board transacted the following business:

Approved the minutes of the 1949 annual meeting.

Approved the Editor's Report.

Approved the Secretary's Report.

Approved the Journal Management Committee Report.

Approved the Auditing Committee Report.

Approved a Budget for 1951 amounting to $40,000.

Approved the Resolutions Committee Report.

Elected W. V. Price as a member of the Journal Management Committee to serve for three years (1951–52–53).

Re-employed F. E. Nelson as Editor for the ensuing year (1951).

Re-employed P. R. Ellsworth as Secretary-Treasurer for the ensuing year (1951).

Approved the Honors Committee selection of Martin J. Prucha as Honorary Member.

Voted to recommend to the Association that dues be changed as follows effective January 1951:

Members from $6.00 to $8.00
Student affiliates from $3.00 to $5.00
Subscribers—no change

Voted to recommend that the membership list be published in the December issue of the Journal every other year, with names of new members only being published on the alternate years.

Voted to recommend that the Association discontinue publication of Student Affiliate membership lists.

Renewed Student Affiliate Branch Certificates for University of Missouri, University of Nebraska, Pennsylvania State College, Clemson, Texas Technological College and State College of Washington.

Appointed W. E. Krauss as American Dairy Science Association representative on the National Research Council.

Recommends that a plan of rotation of annual meeting locations be instituted as a general guide for future meetings whereby meetings may be held in the Midwest every other year (odd) and in the West, South and East in rotation on the alternate years (even). This plan of rotation to be followed only to the extent possible, based on invitations received and other matters beyond the

control of the Association. Final decision to be made by the Executive Board.

Appointed K. L. Turk to succeed himself as American Dairy Science Association representative on the Ralston Purina Co. Research Fellowship Awards Committee.

Voted to recommend approval of the Breed Relations Committee Report.

Adopted Extension Committee Report on Extension Award.

Voted to commend the Milk Industry Foundation for their vision in establishing awards recognizing leadership among Dairy Students in United States and Canada.

The American Dairy Science Association Nominating Committee nominated the following candidates in April: Vice-President, H. A. Bendixen and G. H. Wilster; Directors, J. H. Erb, B. E. Horrall, L. A. Moore, W. H. Riddell.

Results of the election were announced on June 1 as follows: Vice-President, H. A. Bendixen of Washington; Directors, J. H. Erb of Ohio and L. A. Moore of Washington, D.C.

Upon motion duly seconded, the minutes were approved.

President Trout called on R. J. Ramsey who told of plans for the dairy products judging contest at Atlantic City in October, and A. C. Dahlberg who told of the work of the National Research Council on milk regulation studies.

W. E. Petersen moved and F. J. Arnold seconded that all action of the Executive Board during the past year be approved.

THE AMERICAN DAIRY SCIENCE ASSOCIATION AWARDS

Ithaca, New York, June 22, 1950

J. M. Sherman, acting as toastmaster at the annual Awards Banquet at Statler Inn, Cornell University, Ithaca, New York, presented G. M. Trout, President of the Association, who installed the officers-elect as follows: R. B. Becker of Florida as President: H. A. Bendixen of Washington as Vice-President; J. H. Erb of Ohio and L. A. Moore of Washington, D.C. as Directors.

"Mr. Becker, you are about to take over the responsibilities of President of the American Dairy Science Association. As President it will be your duty to be chairman of the Executive Board and submit to the Board for approval the nominations of members to fill vacancies that may occur among the elected officers of the Association. As President you shall appoint, without the approval of the Executive Board, the standing non-elective committees of the Association. With these obligations, privileges and responsibilities, I now charge you with the honor of being President of the American Dairy Science Association with all the privileges, responsibilities and obligations pertaining thereto."

"Mr. Bendixen, you are about to take over the responsibilities of Vice-President of the American Dairy Science Association. As Vice-President, it will be your duty to preside over the Executive Board in the absence of the President and assume other duties of the Executive Board. At the expiration of President Becker's term, you will automatically become President of this Association. I now charge you with these duties."

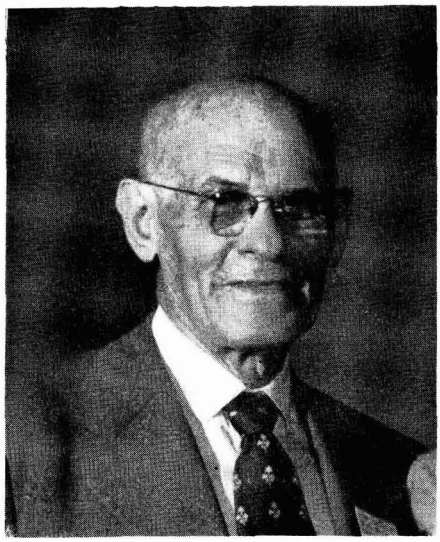
"Mr. Erb and Mr. Moore, you were elected to the Executive Board of the American Dairy Science Association. It is the duty of the Board members to pass on all applications for the establishment of divisions, sections and student branches of the Association. You will have full control of the budget and general business of the Association and have title to all property and funds of the Association. You will be members of the Board that has all the rights and power vested in the by-laws of the Association. With these privileges, responsibilities, and obligations you are now considered as members of the Executive Board of the American Dairy Science Association to serve a term of 3 years."

President Trout then introduced Fordyce Ely, Chairman of the Honors Committee, who read the following citation:

"There comes a time in the life of a man when his friends, associates and colleagues wish to do him honor. Usually it is for a job well done and in such a way as to excite a tribute from fellow workers in the same or closely allied fields of endeavor. Will Martin John Prucha, Professor Emeritus at the University of Illinois, please come forward.

Martin John Prucha was born November 11, 1874, in Jezov, Bohemia. He came to this country at the tender age of 15 yr. to seek his fortune. Having served an apprenticeship as a baker's helper in Bohemia, he began his career in this country working in a bakery in Cleveland, Ohio. Four years on this job convinced this ambitious young man that his future in this country depended on his further education. Accordingly, he enrolled in a Lutheran College (Calvin) for 1 yr. followed by 3.5 yr. at Mt. Herman School for Boys, Mt. Herman, Mass.

He then entered Wesleyan University, Middletown, Conn., graduating in 1903. There he studied under H. W. Conn, often referred to as the father of dairy bacteriology in this country. Next, he accepted a position as Assistant Bacteriologist at the New York Agricultural Experiment Station at Geneva, N. Y., where he worked under the supervision of Dr. H. A. Harding. He earned



MARTIN JOHN PRUCHA

his M.S. degree at Wesleyan University in 1908, studying under Conn and Atwater, the latter a chemist. He accepted a fellowship here at Cornell, 1910–1912, following which he was appointed as an instructor in plant physiology. He was made an assistant professor a short time after completing his work for the Ph.D. degree, studying in the field of physiology of bacteria. A few months later, still in 1913, he accepted an appointment as Assistant Professor of Dairy Bacteriology at the University of Illinois, where he served so well until his retirement in 1943.

In 1907 he married a beautiful young lady, Elizabeth Catchpole, of Geneva, N. Y. Three children blessed this union: A. A. Prucha, County Sanitary Civil Engineer, Marin County, Calif.; Mrs. R. C. (Marjorie) Hodgman, 703 Arlington Road, Penn Valley, Penn.; and M. J. Prucha, Jr., Geo-physicist for the Shell Oil, Co., Houston, Texas.

Dr. Prucha's research has been largely in the field of dairy farm and dairy plant sanitation. His earliest work had to do with a chemical study of the ripening of cheese. His exhaustive studies of the sources of bacteria that gain entrance to milk and dairy products are classic. From his extensive studies of the effect of different gases upon bacteria, has evolved the process of whipping cream by charging it with gas followed by a quick release of the pressure. His work dealing with the sanitary aspects of paper milk containers led to their adoption by the Chicago Health Department and later by other health departments throughout the United States. Dr. Prucha was one of the early workers in the field of chemical sterilizers. He devoted much of his time to research to determine the relationship of chemical sterilizers and washing powders to the corrosion of metals. Within the past year Dr. Prucha was presented with an award by the Chicago Dairy Technology Society in recognition of his outstanding career as a dairy scientist.

Dr. Prucha has been a good servant of the dairy industry. He is loved by his students and admired and respected by his fellow workers. He is cheerful at all times and enthusiastic about the future of the dairy industry. He has always championed the cause of high quality milk and dairy products, and he has emphasized character and proficiency in his work with students. His philosophy has been, "Do what you think is right and don't worry about it."

Dr. Prucha is also an active worker in the Episcopal Church and a member of the Exchange Club. His undergraduate social fraternity was Delta Tau Delta. He is a member of Gamma Sigma Delta honor society and Sigma Xi. He has been a member of the American Dairy Science Association for many years and a liberal contributor to the Journal of Dairy Science. He is also a member of the American Public Health Association and the International Association of Food and Milk Sanitarians.

Though retired for 7 yr., Dr. Prucha is still active. He continues to carry on a limited amount of research work and regularly attends industry and professional meetings. He has a summer home at Christian Assembly, Frankfort, Mich., and his legal residence is 702 W. Nevada, Urbana, Ill.

It seems singularly appropriate to honor Dr. Prucha while our meeting is here at Cornell, where he spent several happy years.

Dr. Prucha, by virtue of authority vested in me as chairman of the Honors Committee by our Executive Board, it is indeed a pleasure to confer upon you an honorary membership in the American Dairy Science Association, a small tribute to your years of service to the dairy industry as a dairy scientist, a teacher and a friend to all."

I. A. Gould, Chairman of the Borden Award Committee for Manufacturing, was introduced and read the following:

"The man selected for the 1950 Borden Award in Dairy Manufacturing is recognized as a researcher, a teacher and a counselor of men. He has left his imprint in the advancement of dairy science not only by the research he has conducted or directed, but also by the training and assistance he has given others so that they, in turn, would be equipped and inspired to continue to make further contributions to the dairy industry.

This year's recipient has been engaged in research and teaching for 25 yr. During this span, he has been author or co-author of almost one hundred scientific and popular papers, reports and bulletins. More than one-third of the publications are original scientific papers, the majority of which have been published in the Journal of Dairy Science. He has given unstintingly of his time as a major professor, teacher, adviser or counselor for a large number of students conducting work for advanced degrees, many of whom have since assumed key positions in the dairy industry. In addition, during the past 20 yr. he has instructed more than 1,000 students in short-course and 4-yr. programs.

His research has been almost entirely confined to the field of cheese, and his selection for the award is based primarily on fundamental and applied research dealing with cheddar and brick varieties. He early demonstrated that pasteurized milk could be used successfully for cheesemaking and established proper processing and manufacturing procedures for pasteurized milk cheese. Through a series of researches, he revealed the necessity of maintaining proper pH and acidity control during the cheesemaking operation in order to insure the cheese against the development of objectionable flavors during storage. Within recent years, he has been associated with fundamental research dealing with the enzyme system of cheddar cheese, particularly with the lipase and proteinase enzymes and the chemical changes which result from their action. Another series of studies were made which revealed the relationship of the diacetyl content of cheddar cheese to flavor production. Research was also conducted and publication made on the development and application of methods for testing cheese for fat and moisture and for analyzing cheese for extraneous material. His studies on these analytical procedures serve as a basis for methods and techniques now generally used by the cheese industry. In addition, he has given attention to problems of cottage and cream cheese, to the relationship of calcium chloride concentration to rennet action, and to the mechanization of cheesemaking practices.

The choice for the 1950 award was born in Schenectady, N. Y., in 1896. He served in the United States Navy during World War I. He attended Cornell University both as an undergraduate and a graduate, receiving the Bachelor of Science Degree in 1920, the Master of Science in 1921 and the Doctor of Philosophy in 1925. Prior to the completion of his formal education, he gained commercial experience by working in market milk and ice cream plants in New York State. He served on the staff at Cornell University for about 4 yr. following receipt of his doctor's degree and then accepted a position as Professor of Dairy Industry at the University of Wisconsin in 1929—a position he still holds.

He has served as a director of the American Dairy Science Association and as a member of committees of the Association concerned with cheese research and standards. He is the co-author of a textbook on cheesemaking which is accepted by the Industry as a standard reference book.

WALTER VAN PRICE

On the basis of his outstanding contributions to our knowledge of the technology of cheese manufacturing, with particular reference to the cheddar and brick varieties, the Borden Award Committee for Dairy Manufacturing of the American Dairy Science Association has chosen Dr. Walter Van Price, Professor of Dairy Industry, University of Wisconsin, for the 1950 award."

Mr. W. A. Wentworth of the Borden Company Foundation presented Dr. Price with a gold medal and check for $1,000,00.

G. W. Salisbury, Chairman of the Borden Award Committee for Production, then was introduced and made the following statement:

"Research in the field of dairy production has undergone profound changes since studies in this field were first introduced into the routine curricula of American colleges nearly a half century ago. Especially during the last 25 yr. have these

changes been directed more and more towards emphasis on the fundamentals of the vital chemistry and physiology of the dairy cow and the lactation function. The 1950 recipient of the Borden Award in Dairy Production has witnessed many of these changes and during the past 25 yr. has contributed as much as any living man to knowledge of the fundamental energy metabolism of the dairy cow. A naturalized American citizen, he was born on a general farm in Garbatchi, Lithuania, on February 8, 1890. He came to the

SAMUEL BRODY

United States as a young man and received his American citizenship in 1912. He received the A.B. degree from the University of California in 1917, was for a time in the Department of Chemistry and Physics in the College of Physicians and Surgeons of San Francisco, and then entered the United States Army, first in aviation and later in chemical warfare service, 1917–1918. He was Assistant in Biochemistry at the University of California from 1919 to 1920, when he received the M.A. degree.

He joined the Department of Dairy Husbandry at the University of Missouri in 1920 as an Assistant Professor and has risen through the successive ranks to a professorship in that Department. He received the Doctor of Philosophy degree from the University of Chicago in 1928, his work having been supported in part by grants from the National Research Council. Later, he was awarded a Guggenheim Memorial Foundation Scholarship and studied at Strasbourg, Paris, Berlin, Copenhagen and Moscow during 1930–1931. He served as chairman of the joint committee between Agriculture and Biological Chemistry for the Herman Frasch Foundation Studies at the University of Missouri from 1929 to 1940. These studies led to the production of a large number of papers on the general subject of growth and development with special reference to domestic animals. In these studies, a wide area of subject matter was covered and many contributions to knowledge made. The major emphasis was on dairy cattle and from this work our recipient published 65 research bulletins of the Missouri Agricultural Experiment Station. From 1921 to date, he has contributed 62 articles to scientific journals, and has written a number of scientific reviews on his specialty, including the section on growth for the recent edition of the Encyclopedia Britannica.

Dr. Samuel Brody, the 1950 recipient of the Borden Award in Dairy Production, is author of the monumental work *Bioenergetics and Growth.* During the period 1944 to 1949, he has published 14 research bulletins of the Missouri Agricultural Experiment Station, most of them dealing with the relationship of temperature to the energy metabolism of cattle and the milking function. He has published 15 scientific articles in research journals, most of which deal with the effects of growth and aging upon domestic animals. It is on the basis of these studies that the Dairy Production Committee unanimously selected Dr. Brody as the 1950 recipient of the Borden Award in Dairy Production. From his work, many of the dairy cattle management practices of the future will rest on a firm, scientific basis.

On behalf of the Committee on the Borden Award for Dairy Production and our colleagues in the Production Section of the American Dairy Science Association, it is a pleasure to present Dr. Samuel Brody, Professor of Dairy Husbandry at the University of Missouri, to receive the Award."

Mr. W. A. Wentworth of the Borden Company Foundation presented Dr. Brody with a gold medal and a check for $1,000.00.

AMERICAN FEED MANUFACTURERS' AWARD

R. B. Becker, Chairman of the American Feed Manufacturers' Award Committee, was introduced and spoke as follows:

"For 3 yr., the American Feed Manufacturers' Association has encouraged superior original research in dairy cattle nutrition, and recognized the worker who made the outstanding contribu-

tions, under rules established by the American Dairy Science Association.

The Committee for the American Feed Manufacturers' Association Award received 14 nominations this year, and found 12 others eligible from work published in dairy nutrition during 1948 to 1949. Evaluation of the publications narrowed the list to eight close contenders. From these the candidate was named on the first ballot.

J. THOMAS REID

The research which made the candidate eligible appeared in four technical journals during the prescribed period. It added to knowledge concerning bovine saliva, an indicator method for digestibility of forage by ruminants, efficiency of simple rations for dairy bulls, calcium and manganese metabolism with cows and calves. A number of collaborators assisted the author with the investigations.

The candidate was schooled in Maryland and Michigan. He has been engaged in dairy nutrition research for 10 yr. at Michigan, New Jersey and New York, and is one of our hosts at this delightful annual meeting. He is Dr. J. Thomas Reid.

Please come forward, Dr. Reid.

Dr. H. Ernest Bechtel, chairman of the Nutrition Council of the American Feed Manufacturers' Association, will present the award.

Dr. Bechtel, our Committee presents as candidate of the American Dairy Science Association for the American Feed Manufacturers' Association award—Dr. J. Thomas Reid."

H. E. Bechtel, Chairman of the Nutrition Council of the American Feed Manufacturers' Association, then presented Dr. Reid with a check for $1,000.00.

VOLUME XXXIII AUGUST, 1950 NUMBER 8

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

551. Farm Structures. H. J. BARRE AND L. L. SAMMET. John Wiley & Sons, Inc., New York, N. Y. 650 pp. $7.00. 1950.

Although written primarily for professional agricultural engineering students with a background in mechanics and strength of materials, this book contains considerable amounts of material of interest to those with less specialized background. Properties of structural materials, heating and heat transfer, moisture condensation and humidity, calculations of structures needed for different purposes and principles of satisfactory arrangement are covered. Factors concerned in the design and construction of many special types of buildings, including dairy barns and milk houses, are presented in a series of special chapters. In a number of cases, factors to be considered in the design of small milk plants are mentioned briefly. Material on space and structure demands for various operations in dairy barns and other buildings is summarized in readily understandable form. This should be an extremely valuable reference book for those having any interest in farm buildings. F. E. Nelson

552. Advances in Enzymology, vol. 10. F. E. NORD, editor. Interscience Publishers, Inc., New York, N. Y. 533 pp. $7.50. 1950.

The reviews included are: Blood clotting and related processes, by T. Astrup; Tryptophanase-tryptophan reaction, by F. C. Happold; Phosphatase alcaline, by J. Roche and Nguyen-van Thoai; Synthesis of disaccharides with bacterial enzymes, by W. Z. Hassid and M. Duodroff; Some aspects of streptomycin and other *Streptomyces* antibiotics, by N. G. Brink and K. Folkers; Probleme des Citronensäurecyklus, by Martins and F. Lynen; Die Phytochemie des Schwefels, by T. Bersin; Chemical changes in the harvested tobacco leaf: Part II. Chemical and enzymic conversions during fermentation and aging, by W. G. Frankenburg; and Assimilation of hydrocarbons, by C. E. Zobell.

Adequate author and subject indices for this volume are included. The individual reviews are well-documented and appear to measure up to the standards set by the earlier publications in the series. F. E. Nelson

ANIMAL DISEASES

W. D. POUNDEN, SECTION EDITOR

553. Prophlaxie contre la tuberculose bovine, production laitiere et B C G. (Prophylaxis against bovine tuberculosis, milk production and "B.C.G.") G. THIEULEN. Lait, **30,** 293–294: 141–147. Mar.–Apr., 1950.

The problem of bovine tuberculosis in France and statutes bearing on the matter are reviewed. It is proposed that the only valid method of dealing with the problem is through the use of B.C.G. vaccine which procedure is discussed. Effectiveness of this method would depend upon changes in sanitary regulations and certain other laws. S. Patton

BUTTER

O. F. HUNZIKER, SECTION EDITOR

554. Method of manufacturing butter. H. A. TOULMIN, JR. (Assignor to Commonwealth Engineering Co.). U. S. Patent 2,505,654. 12 claims. April 25, 1950. Official Gaz. U. S. Pat. Office, **633,** 4: 1270. 1950.

Cream first is concentrated by removing water after it is frozen. The cream then is thawed and finally churned to form butter.

R. Whitaker

Also see abs. no. 581, 587.

CHEESE

A. C. DAHLBERG, SECTION EDITOR

555. Sur la maturation des fromages. (On the

ripening of cheeses). M. BEAN. Lait, **30,** 293–294: 122–141. Mar.–April, 1950.

Polarization, titration and precipitation methods for estimating the maturity of cheeses and the extent and type of proteolysis taking place during ripening were studied and evaluated. It is indicated that the various methods leave something to be desired with respect to measuring the quantity and types of amino acids present at various stages of ripening and in various types of cheese. S. Patton

556. Manufacture of cheese. G. W. MCDONALD and E. C. SCOTT (assignors to Swift and Co.). U. S. Patent 2,507,480. 8 claims. May 9, 1950. Official Gaz. U. S. Pat. Office, **634,** 2: 642. 1950.

The lactalbumin in whey is precipitated in large particles, homogenized and added to milk in amounts ranging from 1–50 parts of the casein. The modified milk then is curdled by an acid which produces a curd in which the added lactalbumin is uniformly dispersed. Cheese made from this curd has improved nutritional value and moisture-holding properties.
R. Whitaker

557. Making a quality cottage cheese. N. C. ANGEVINE, Meyer-Blanke Co., St. Louis, Mo. Milk Dealer, **39,** 8: 51–52, 102–107. May, 1950.

Sales of cottage cheese have increased tremendously in the past several years, partly because of its current value as a replacement for other animal proteins in the human diet and partly because the consuming public is beginning to realize its real importance as a food. Also, a large portion of cottage cheese manufacturers are treating it as a major product, much the same as ice cream, butter and fluid milk. The quality definitely is being improved.

Based upon the 1930 census, cottage cheese consumption in 1925 was less than 0.5 lb./person. In 1935, it was 0.9 lb. Based on the 1940 census, the 1940 per capita consumption was 1.3 lb., the 1943 was 1.6 lb., and the 1947 estimated at 3.21 lb. The 1948 per capita consumption, based on probable 1950 census, is estimated at 3.36 lb. Methods of manufacturing cottage cheese are discussed. C. J. Babcock

558. Process for the manufacture of cream cheese. R. P. CHENIER. U. S. Patent 2,508, 663. 1 claim. May 23, 1950. Official Gaz. U. S. Pat. Office, **634,** 4: 1166. 1950.

Cream cheese containing about 75% fat is made by pasteurizing cream-enriched milk with infrared rays, cooling and again treating with infrared rays, and holding for about 3 d. at 40° F. A rennet curd made from infrared pasteurized milk is washed, drained and mixed with the aged cream and a stabilizer, such as gum tragacanth, gelose and pectin. The product is beaten to incorporate air in well dispersed small bubbles.
R. Whitaker

559. Het Schreuder-Kaasvat. (The Schreuder cheese vat.) (English summary.) Dutch Association of Co-operative Dairy Factories, The Hague, Holland. 18 pages. Feb., 1950.

A new type of cheese vat for Edam cheese, described in the Netherlands, patent no. 45643, was tried for usefulness and efficiency. It is constructed in such a way that the cheese, when it comes out of the brine, has flattened sides. This facilitates placing and turning of the cheese on the shelves and produces a much better shape of cheese with considerably less labor. There was some trouble with the cloth sticking to the cheese. Some factories experienced no particular difficulty in this respect. It may therefore, be possible for each factory to evolve its own special method to prevent sticking of the cloth. In this case, the use of the new type of cheese vat may be strongly recommended. A. F. Tamsma

560. Cheese making method. R. MIOLLIS. U. S. Patent 2,505,984. 6 claims. May 2, 1950. Official Gaz. U. S. Pat. Office, **634,** 1: 160. 1950.

Whey is drained from curd in 3 steps, some being removed in the vat in which the curd is formed, some as the curd is transferred to a 2nd vat and some while further drainage is accomplished in the 2nd vat. The curd finally is transferred to a 3rd vat for matting. R. Whitaker

561. Cheese merchandising and public relations. T. B. COOPER. Can. Dairy Ice Cream J., **29,** 4: 86–89, 96. Apr., 1950.

The only market for Canadian cheese is Great Britain. There has been very little attempt to encourage greater home consumption. The Canadian consumption of cheese is approximately 4.2 lb./person/year. A great number of Canadians never buy any cheese in any quantity. To increase the consumption of cheese, a National Cheese Week was sponsored by the National Dairy Council of Canada. There is a need for consumer education on cheese and better merchandising methods. H. Pyenson

562. Cheese merchandising. O. R. IRVINE and W. H. SPROULE. Can. Dairy Ice Cream J., **29,** 5: 29–32. May, 1950.

Sales of process cheese were stimulated at the expense of natural cheese because of better packaging, greater uniformity, lack of waste, etc. During and since the war, a number of packag-

ing materials have been developed for packaging natural cheese. These comprise the transparent or semi-transparent films possessing heat-sealing properties and capable of being printed in attractive colors. A good package should: (a) protect the product, (b) identify the product, (c) have low cost, (d) be adaptable to machine application and (e) be light in weight. The Goodyear Tire and Rubber Co. has developed the pliofilm pressure-pack method where 20- or 40-lb. square hoops are used and pliofilm and glassine paper wrapped around the cheese. When the cheese has been aged sufficiently, they are unwrapped, cut in 0.5-, 1-, 2-, or 5-lb. prints and double-wrapped in pliofilm. Wedge-shaped prints also have been developed by this method. Another method (Milprint, Inc.) cuts cheddars in wedges, the rinds are not removed. Each piece is weighed and marked separately. Kraft has developed a wax-coated cellophane. Special waxes also have been developed for retailing cheese. H. Pyenson

Also see abs. no. 566, 573.

CONDENSED AND DRIED MILKS; BY–PRODUCTS

F. J. DOAN, SECTION EDITOR

563. Etude, au microscope electronique de la structure du lait en poudre "Spray." (Electron microscope study of the structure of spray dried milk powder.) A. C. VILLANOVA and O. BALLARIN. Lait, **30,** 293–294: 114–122. Mar.–Apr., 1950.

By means of an electron microscope, photomicrographs (published with the paper) of spray dried milk powder particles were obtained. Original enlargements of the particles by the microscope were on the order of 3,500–12,500 diameters. Further magnification, up to 50,000 diameters, was attained by photographic enlargement.

The results indicate that the milk components are distributed evenly throughout the powder particle. The fat is very highly divided and certain of the salts are crystallized. Lactose did not appear to be crystallized. S. Patton

564. What's ahead of the concentrated milk industry in Canada? D. B. GOODWILLIE. Can. Dairy Ice Cream J., **29,** 4: 52–56. Apr., 1950.

Consumption of concentrated milk products has increased materially the last 10 yr. and indications point to this trend continuing. Canada imports little concentrated milk. It exported in 1949 approximately 79 million lb., having a value of $12.9 million. Evaporated milk buyers are not anticipating their requirements very far in advance, possibly expecting lower prices. The sweetened condensed milk peak was reached in 1948 and production has dropped sharply since. Dry whole milk production, consumption and export have gone down considerably. Dry skim production last year was practically the same as in 1948. The amount of spray process produced has increased and the amount of roller process has decreased. Domestic consumption last year was one of the highest on record.

H. Pyenson

565. The freezing point of reconstituted non-fat and dry milk solids. J. G. FEATRO and A. V. MOORE, Texas Agr. Expt. Sta., College Station. J. Milk & Food Technol, **13:** 167–169. May–June, 1950.

Drying of skimmilk solids tends to decrease the solubility of certain milk constituents and thus raise the freezing point of the reconstituted product. When fresh normal whole milk is mixed equally with reconstituted non-fat dry milk solids, the freezing point of the blend will be comparable to whole milk, providing the reconstituted non-fat dry milk solids product is 9.3% solids. The freezing point does not detect a skimmilk made by reconstituting a non-fat dry milk solids of 9.3% solids. There appears to be no difference between the freezing point of freshly reconstituted non-fat dry milk and milk held at 45° F. for 48 hr.

H. H. Weiser

566. Use of nonfat dry milk solids in the making of cottage cheese and cultured buttermilk. J. C. STILES, Golden State Co. Milk Dealer, **39,** 8: 132–138. May, 1950.

A high per capita consumption of cottage cheese and buttermilk will result only when the consumer has a quality product 12 mo. a year. Use of low-heat nonfat dry milk solids offers the cottage cheese manufacturer a dependable source of solids to place production of a quality product on a year-round basis. The dependable source of uniform high-quality solids also will help to make buttermilk a profitable, year-round specialty. Directions are given for the use of low-heat dry milk solids in the preparation of cottage cheese and buttermilk. C. J. Babcock

567. Reconstituting milk. A. O. DAHLBERG. Can. Dairy Ice Cream J., **29,** 5: 36–37, 42. May, 1950.

For beverage use there has developed a market for reconstituted milk made from high quality, dry milk fat and low-heat, nonfat dry milk solids. This method has been used in Japan, South Pacific, Alaska and the Aleutians. Five milk reconstituting plants are now operating in Japan and 1 each on Okinawa and Guam. The U. S.

Army has certain specifications that must be met for the dry milk fat and nonfat dry milk solids. Reconstitution is accomplished with equipment ordinarily found in a creamery. The use of high quality raw materials can not be over-emphasized. The dry butterfat and the nonfat dry milk solids probably will be used in ice cream, also.

H. Pyenson

568. Der Eiweissgehalt von Gärungsmolkengetränken. (The protein content of fermented whey beverages.). (English summary.) K. KUMETAT. Die Milchwissenschaft, **4,** 2: 53, 55. Feb., 1949.

Milone (a fermented whey beverage) and beer were analyzed for total N, tannic acid precipitation fraction of N (Lundin method) and formol titration value of N. Milone had an average total N value of 25 mg.%, whereas light beer had an average value of 64 mg.% and dark beer of 86 mg.%. In milone, 48% of the total N (12 mg.%) was precipitated with tannic acid as against 7.4% (5 mg.%) in light beer and 4.6% (4.1 mg.%) in dark beer. These values show that there were fewer protein degradation products in milone than in either type of beer. The average formol titration value for milone was 25% of the total N value (6.4 mg.%) and for light beer 31% (22 mg.%).

In the method of Lundin, 200 ml. milone were pipetted into a 25-ml. vol. flask. To this were added 6 ml. of 50% H_2SO_4 and 12 ml. of 16% tannic acid, the mixture adjusted to 20° C., made to volume with water and filtered. The N-determination was made by the Kjeldahl method, using the condensate from 100 ml. of original filtrate.

I. Peters

569. Method of producing a lacteal beverage. E. C. SCOTT (assignor to Swift and Co.). U. S. Patent 2,507,482. 2 claims. May 9, 1950. Official Gaz. U. S. Pat. Office, **634,** 2: 643. 1950.

A milk shake having a texture and body similar to a milk shake prepared from ice cream is made from a dry mix containing 15–35% butter fat, 20–40% milk solids-not-fat and 20–40% sugar. The powder first is made into a paste, using 25–75 parts water to 100 parts powder. Flavoring then is added and the finished drink prepared by briskly agitating 75–200 parts of chopped ice with 100 parts of dry powder.

R. Whitaker

DAIRY BACTERIOLOGY

P. R. ELLIKER, SECTION EDITOR

570. Heat resistant bacteria in raw milk. Part I. Comparison of thermoduric colony counts on yeastrel milk agar incubated for 2 days at 37° C. and 4 days at 30° C. S. B. THOMAS, DOROTHY ELLISON, D. G. GRIFFITHS, E. JENKINS and K. J. MORGAN. J. Soc. Dairy Technol., **3,** 3: 187–190. Apr., 1950.

Milk samples were pasteurized in the laboratory at 63.5° C. for 35 min. before plating. Over 80% of the samples had higher counts at 30° C. than at 37° C. Samples with low counts at 37° C. showed the greatest difference between the 2 temperatures, while samples with high counts at 37° C. showed relatively slight difference between 30 and 37° C. It was assumed that the larger differences between the 2 counts were due to the presence of microbacteria and certain micrococci incapable of growing at 37° C., while small differences were due to the presence of a relatively high proportion of thermoduric streptococci that could grow at both temperatures.

The authors recommend an incubation temperature of 30° C. for thermoduric plate counts of milk, utensil rinses and swabs instead of or in addition to the 37° C. ordinarily used.

E. M. Foster

571. Heat resistant bacteria in raw milk. Part II. Grading farm milk supplies by keeping quality and thermoduric colony count. S. B. THOMAS, DOROTHY ELLISON, D. G. GRIFFITHS, M. HUMPHREYS, W. L. R. VAUGHAN, G. GEORGE and E. P. DAVIES. J. Soc. Dairy Technol., **3,** 3: 190–195. Apr., 1950.

Over 3600 samples of milk were examined for numbers of thermoduric bacteria and for keeping quality at 20° C. Thermoduric counts were obtained from yeastrel agar plates incubated at 30° C. Keeping quality was expressed as time required to clot on boiling. The results showed a general association between the 2 tests in that a high proportion of samples of good keeping quality had low thermoduric counts and nearly half the samples of poor keeping quality had high thermoduric counts. A system of grading milk into 4 classes on the basis of these 2 tests is suggested. The difficulties in interpreting the results are recognized and suggestions are made to aid in their interpretation.

E. M. Foster

572. Types of organisms present in commercially pasteurized milk. J. W. EGDELL and E. R. BIRD. J. Soc. Dairy Technol., **3,** 3: 171–177. Apr., 1950.

From 11 dairies in the west of England, 21 samples of milk were taken directly from the pasteurizers and another 21 samples representing the same batches were taken after bottling. Each sample was plated on yeastrel milk agar and plates incubated at 22, 30 and 37° C. Colonies were

picked at random from the plates and the organisms identified.

Average counts at 22 and 30° C. were 4–5 times higher than were those at 37° C. Of the isolants from the 37° C. plates, 48% were streptococci, 28% were micrococci and 16% were aerobic spore-forming rods. However, the cultures from the 30° C. plates were distributed thus: 47% microbacteria, 20% micrococci, 16% streptococic and 12% aerobic spore-forming rods. The proportion of microbacteria in the 22° C. plates was even higher (65%) with micrococci (17%) and streptococci (10%) accounting for most of the remainder. Practically all of the microbacteria were *Microbacterium lacticum,* while *Streptococcus thermophilus* accounted for all but 1 of the streptococci identified. The micrococci and aerobic spore-forming rods were distributed among several groups and species.

Streptococcus lactis and coliform organisms were not found in 1-ml. quantities of the samples immediately after pasteurization but were found in the milk after storage at 18° C. This was not believed to indicate post-pasteurization contamination but, rather, that these organisms survived the commercial pasteurization in very small numbers and then grew during storage.

The authors suggest that the reason for lower counts on pasteurized milk plates incubated at 37° C. than at 30° C. is due to the failure of microbacteria and certain micrococci to grow at the higher temperatures. E. M. Foster

573. Cultures and starters for cheesemaking. M. W. Hales. Can. Dairy Ice Cream J., **29,** 5: 50–60. May, 1950.

This article covers (a) functions of bacteria in lactic cultures, (b) selection of milk, (c) heating milk, (d) inoculating milk, (e) incubation of cultures and starters, (f) ripening, (g) influence of cooking temperatures on acid development in cheesemaking and (h) bacteriophage.

H. Pyenson

574. Ein Pilznärboden als vollwertiger Ersatz für Fleisch- und Pepton-Nahrböden. (A fungus growth medium as substitute for meat infusion or peptone media.) (English summary.) W. Kundrat. Die Milchwissenschaft, **4,** 2: 55–56. Feb., 1949.

A number of test organisms, including bacteria, yeasts and molds, grew equally as well or better on a mushroom infusion agar than on such commonly used media as meat infusion agar, nutrient agar or acidified potato dextrose agar. Equally good growth of test organisms was obtained by using the tops of (a) edible mushrooms only, (b) both edible and non-edible and (c) a very bitter mushroom (*Boletus felleus* Bull).

The mushroom infusion agar was prepared by boiling 500 g. of mushroom tops in 500 ml. of tap water, filtering and adjusting the filtrate with additional water to 1 l. Two per cent agar was added to the filtrate and the medium sterilized in the regular manner. When air-dried ground mushrooms were used, the equivalent of 350–400 g. of fresh mushrooms/l. gave optimum microbial growth, thus resulting in a saving of from 20–30% of mushroms. I. Peters

575. Penicillin, as an adjunct to the preservation of quality of raw and pasteurized milk. E. J. Foley and J. V. Byrne, Wallace Research Laboratories. J. Milk & Food Technol., **13,** 170–174. May–June, 1950.

The effects of penicillin were studied on the bacterial counts of raw and pasteurized milks held at different temperatures under laboratory conditions. The results are not conclusive. However, the study shows that 3 units of penicillin/ml. can suppress the growth of certain species of bacteria in milk held at the most favorable temperature for bacterial growth. H. H. Weiser

576. Orotic acid, a growth factor for Lactobacillus bulgaricus. L. D. Wright, J. W. Huff, H. R. Skeggs, K. A. Valentik and D. K. Bosshardt, Sharp & Dohme, Inc., Glenolden, Pa. J. Am. Chem. Soc., **72,** 5: 2312–2313. May, 1950.

Some strains of *Lactobacillus bugaricus,* such as strain 09 of the Cornell collection, require another factor(s) besides LBF. Yeast extract and whey are good natural sources of the growth promoting substance. At a level of 10–100γ/tube, orotic acid (uracil-4-carboxylic acid) was found to replace the need for large amounts of natural material. The factor could not be replaced by uracil, uridine, uridylic acid, cytosine, cytidylic acid, uric acid, asparagine, aspartic acid, lactose, urea, alloxan, allantoin, thymine, γ-aminobutyric acid, 5-carboxyuracil, 4-methyluracil and 2-amino-4-methyl-6-hydroxypyrimidine. H. J. Peppler

577. The iron requirement of rumen bacteria. (Abs.) Mary L. McNaught and E. C. Owne, Hannah Dairy Research Inst., Kirkhill, Ayr. Biochem. J., **44,** 3: xxiv. 1949.

Studies of rumen bacteria *in vitro* indicate that about 1.0 ppm. of iron is essential for their growth.

A. O. Call

DAIRY CHEMISTRY

H. H. SOMMER, SECTION EDITOR

578. The semi-micro estimation of lactose alone

and in the presence of other sugars. F. H. MALPRESS and A. B. MORRISON. Queen's University, Belfast. Biochem. J., **45,** 4: 455–459. 1949.

This method for estimation of small amounts of lactose is based on the color reaction between lactose and methylamine in alkaline solution. The developed color, following a strict time schedule, is measured in a colorimeter. The method is most sensitive in the range of 0.05–0.2%. Some discussion is given regarding interfering substances.
A. O. Call

579. Qualitative scheme of analysis for the common sugars. T. H. WHITEHEAD and W. C. BRADBURY, Univ. of Georgia, Athens. Analyt. Chem., **22,** 5: 651–653. May, 1950.

Mixtures of sucrose, glucose, fructose, maltose and lactose in solid and liquid samples may be analyzed qualitatively without the use of special equipment or unusual techniques and reagents. Fructose is removed from the solid sample with 90% ethyl alcohol. Lactose, starch and dextrins next are removed from the residue with 50% alcohol and the presence of lactose is confirmed with the formation of its osazone. The filtrate, after removal of the lactose residue contains sucrose, glucose and maltose. Sucrose may be detected by its color reaction with cobalt nitrate, and glucose and maltose are separated by forming the osazones. Five mg. of sucrose and fructose or 200 mg. of the other sugars may be detected in a sample. B. H. Webb

580. Fat determinations in milk. L. GERSHENFELD and B. UCKO, Dept. of Bacteriology, Philadelphia Coll. of Pharm., Pa. J. Milk & Food Technol., **13:** 175–176. May–June, 1950.

The authors claim that the Schain method for determining fat content in raw, pasteurized plain and homogenized milks has many advantages over the Babcock test. The test involves the mixing of the sample with solution A (oil red O in isopropyl alcohol with a non-ionic detergent in ethyl alcohol) in a Babcock bottle. Reagent B (a standardized anionic detergent) is added without shaking and the mixture placed in a water bath at 180° F. for exactly 5 min. Water at 180° F. also is added to bring the liquid up to the graduated portion of the neck. The mixture is allowed to stand at room temperature for 20 min. before reading.

In order to compare the fat readings with either the Babcock or Roese-Gottlieb methods, it is necessary to standardize solution A in the Schain procedure for each type of milk. The Schain method is not applicable to buttermilk, creams, ice cream or other milk products.
H. H. Weiser

581. Rancidity in Indian butterfats (Ghee). K. T. ACHAYA, Univ. of Liverpool. Biochem. J., **44,** 5: 561–567. 1949.

Indian butterfat (Ghee) from 3 sources, (a) buffaloes on normal ration, (b) buffaloes heavily fed cottonseed under arid conditions and (c) normal cow butterfat, stored under usual unrefrigerated conditions for a period of 3–4 yr., were used in the study. The common fat constant determinations were made on pooled rancid samples from the 3 sources. Increases in acidity, Polenske, Reichert and saponification numbers, and decreases in iodine values occurred in all cases. An oxidative mechanism producing free fatty acids is suggested in the case of these butter oils as opposed to mainly lipolytic changes in butter on becoming rancid.

Results of the free fatty acids determinations are given in a table. The absence of oleic acid in quantities as large as expected and the presence of unsaturated, nonvolatile residues suggest that polymers were formed during the prolonged storage. A. O. Call

582. An immune globulin fraction from bovine precolostrum. E. I. MCDOUGALL, Univ. of Cambridge. Biochem. J., **44,** 5: 531–541. 1949.

Bovine precolostrum is described as "a viscous honey-like substance obtained from the udders of pregnant heifers at half term." Schematic details of fractionation procedures by salting out are given. The study deals mostly with that fraction salted out by 33% saturation $(NH_4)_2SO_4$ and referred to as an immune globulin. Electrophoretic measurements showed the fraction to contain only 1 component, but solubility tests indicated more than 1 component. A nitrogen content of 15.15% and an apparent molecular weight of 300,000 are given. Although not pure, the fraction represents the main component of precolostrum exhibiting immune properties. The similarity and interrelation of this globulin to those of colostrum and milk are pointed out. A. O. Call

583. Protein reaction product preparation. J. P. DANEHY (Assignor to Harris-Seybold Co.). U. S. Patent 2,500,453. 13 claims. March 14, 1950. Official Gaz. U. S. Pat. Office, **632,** 1: 492. 1950.

To facilitate the production of casein plastics and other products, the casein is dispersed, not in water as is the usual medium, but in compatible organic agents such as glycols, glycerol, acid amides and certain phenols. Aldehyde precipitation then is accomplished in the temp. range of 110–140° C. R. Whitaker

584. pH in the dairy industry. J. G. DAVIS. Food, **19,** 222: 84. Mar., 1950.

This is a second review paper on pH relationships and test procedures of platform testing of milk, and effect of pH on the physical structure of milk. K. G. Weckel

Also see abs. no. 555, 565, 619.

DAIRY ENGINEERING

A. W. FARRELL, SECTION EDITOR

585. Developments in small tube heat exchangers. E. O. HERREID. Can. Dairy Ice Cream J., **29,** 5: 43–44, 92. May, 1950.

The small-tube heat exchanger at the University of Illinois has a capacity of 212 gal./hr. at 2000 lb. pressure. The heating section has 143 ft. of stainless steel tubing, 0.25 in. diameter. The cooling section is of the same construction, and water is used as the cooling medium. The temperature in the heating section is controlled by a Fulscope. The velocity of the product through the entire unit is 23.1 ft./sec. It takes 12.34 sec. to heat and cool the product. The heat exchanger has been used in processing milk, cream and ice cream mix. Test organisms were used in this study. Cream heated to 240–300° F. was made commercially sterile; satisfactory phosphatase values were obtained at 190° F. and above. High velocities reduced the size of the fat globules in cream from 3.1–2.1 μ at a temperature of 300° F. The heat exchanger produced no changes in acidity and hydrogen ion concentration through a temperature range of 170–300° F. for 6.1 sec. at each temperature.

The viscosity of the cream was reduced by about 50% through the temperature range of 200–300° F., while through the range of 170–190° F. the reduction was about 40%. High temperatures did not affect the stability of cream in coffee, although it did have more coloring ability in coffee than raw cream. Cooked flavor became slightly evident at 210–220° F. and pronounced at 240–260° F. but was not objectionable even up to 300° F. The whipping time of the cream was not changed measurably by heating it to 300° F. When the curd tension was reduced by more than 20%, a slight cooked flavor was obtained; when it was reduced to zero at temperatures above 240° F., the flavor of the milk was definitely cooked. With milk a cooked flavor was much less than that found in evaporated milk. In ice cream the whipping time was prolonged, but this condition could be corrected by using an emulsifying agent, in addition to a stabilizer. The best temperatures at which to process ice cream mix in the heat exchanger were 240–250° F. from a flavor standpoint. Heat-resistant vegetative forms in ice cream were destroyed at 170–180° F. Spore formers were destroyed at 240–260° F. Above 180° F. all phosphatase tests were negative. Due to high velocity, there is no laminar flow but a turbulent flow, which prevented cooking the product onto the heating surface. The heater exchanger (Mallorizer) is cleaned easily by circulating alkaline and acid solution through the tubes under pressure.

H. Pyenson

586. Dumping device for milk cans. H. M. KENDALL. U. S. Patent 2,509,393. 12 claims. May 30, 1950. Official Gaz. U. S. Pat. Office, **634,** 5: 1466. 1950.

A tilting device, attached to the end of a conveyor, permits easy emptying of 10-gal. milk cans into a weigh vat or other vessel. R. Whitaker

587. Self-washing cream separator. W. H. HARSTICK (Assignor to International Harvestor Co.). U. S. Patent 2,504,261. 22 claims. April 18, 1950. Official Gaz. U. S. Pat. Office, **633,** 3: 789. 1950.

A centrifugal type cream separator is described, consisting of the usual series of disks within a rotating bowl, so designed and equipped with a rotating tube extending upward through the supply tank that the bowl can be flushed with a cleaning fluid without disassembly.

R. Whitaker

588. Milk and cream product emulsifier. J. H. GARDNER (Assignor to Elizabeth Gardner). U. S. Patent 2,504,678. 13 claims. April 18, 1950. Official Gaz. U. S. Pat. Office, **633,** 3: 896. 1950.

An homogenizer valve in which the milk or cream under high pressure is forced radially outward between perforated disks which are pressed together by a hand screw is described.

R. Whitaker

589. Freezing machine. A. J. TACCHELLA (assignor to Steady Flow-Freezer Co.). U. S. Patent 2,508,435. 16 claims. May 23, 1950. Official Gaz. U. S. Pat. Office, **634,** 4: 1107. 1950.

An ice cream freezer for delivering, intermittently, individual portions of ice cream is described. A foot-actuated mechanism, when depressed, opens the freezer gate valve at the front end of the freezer and also opens a valve at the back end admitting an amount of mix in proportion to the amount of ice cream withdrawn, thus maintaining the optimum amount of ice cream in the freezer at all times.

R. Whitaker

590. Process for washing containers. H. D. LATHROP and V. SCHWARZKOPF (assignors to Lathrop-Paulson Co.). U. S. Patent 2,509,003. 8 claims. May 23, 1950. Official Gaz. U. S. Pat. Office, **634,** 4: 1252. 1950.

A milk can washer which employs a cleaning compound of the type which makes a foam with the milk solids adhering to the walls of the cans is described. The liquid and foam drain into a sump, from the bottom of which the liquid is reused. The foam overflows as some rinse water gains access to the sump. R. Whitaker

591. Tools for saving water. H. E. DEGLER, Marley Co., Kansas City, Kan. Power, **94,** 5: 102–106. May, 1950.

Evaporative cooling is an effective method of conserving cooling water. Spray ponds are costly in space and are relatively inefficient. Many have been replaced by cooling towers and dry coolers.

Spray-filled natural-draft towers serve for cooling requirements of less than 30,000 Btu/min. The atmospheric deck tower is a modification which breaks and rebreaks the fall of the water. These towers should be broadside to prevailing winds and are inefficient in wind velocities under 3 mph.

Mechanical-draft towers fan-produce air movement and are more compact and efficient. Air passes counterflow or across the water streams. In mechanical draft towers, water is either spray-filled or cascaded over wood fillers. They may use combinations of both. Exhaust air is passed through a drift eliminator to remove entrained moisture.

Forced-draft towers are suitable for corrosive waters. The fan is mounted at near ground level, and the warmed air leaves at low velocity at the top of the tower. The warm air may find its way back to the fan inlet and cut performance of tower.

Induced-draft towers have the fan at the top and draw air horizontally across or upward through the filling. The water basin on this type is accessible for cleaning during operation.

Dry coolers may be used where fluid temperature starts above 140° F. or where water is scarce, expensive or badly polluted. The fluid is circulated through finned coils over which air passes.

Illustrations show the main features of these towers and tables present relative cost figures. H. L. Mitten, Jr.

592. Water treatment for cooling towers. J. B. DAVIS, Allis-Chalmers Mfg. Co., Milwaukee, Wis. Heating, Piping & Air Cond., **22,** 4: 89–93. Apr., 1950.

Advantages and disadvantages of once through, closed and open cooling systems are discussed. Cooling system problems in probable order of importance are: (a) scale deposition or fouling, (b) corrosion of metal surfaces and (c) formation of organic growths. Scale preventive procedures are classed as: (a) softening, (b) alkalinity reduction, (c) surface active treatment, (d) deconcentration, (e) sterilization.

Selection of water treatment should be based on availability of water, number of times water can be concentrated without scale deposition and cost of treatment. Tables and diagrams presented give data which can aid in treatment selection. H. L. Mitten, Jr.

593. Rapid test for calcium hardness. V. M. MARCY, Hall Laboratories, Inc., Hagan Bldg., Pittsburgh, Pa. Power, **94,** 6: 92–93. June, 1950.

The method described requires no special techniques, may be used with waters containing as little as 0.5 ppm. Ca and is rapid and accurate. Reagants required are available commercially. They consist of a buffer which is a strong NaOH solution containing Na_2S, an indicator made by adding stabilized ammonium purpurate to distilled water and the titrating solution which contains a complex-forming salt of ethylene-diamine-tetra-acetic acid.

The procedure is as follows: (a) Measure 50 ml. of water sample into a white porcelain cup and add 4 drops of buffer solution to adjust pH to about 12. (b) Add 1–3 drops of indicator. This indicator is violet-blue at pH 12 in Ca-free water, red if Ca is present. (c) Titrate with a standard solution of ethylene-diamine-tetra-acetic acid salt until the violet-blue end point is obtained. (d) Compute results according to the strength of the titrating solution used. H. L. Mitten, Jr.

594. Shooting trouble in a refrigeration system. G. Holman. Heating, Piping & Air Cond., **22,** 4: 100–102. Apr., 1950.

A case history of an ice-building, sweet water system in a dairy is presented. The system had not been properly purged of air and pressurestats needed adjusting. H. L. Mitten, Jr.

595. Are your motors overheating? J. L. WATTS, Southampton, England. Power, **94,** 5: 87–89. May, 1950.

When the supply voltage and motor load are constant, the motor temperature increases gradually and eventually reaches a constant level. Maximum temperature rises are held within allowable limits of motor insulation. When safe temperatures are exceeded, the life expectancy of the motor is reduced. Motors installed in excep-

tionally warm atmospheres should be given reduced loads to keep within safe temperature limits.

In general, the factors which cause motors to overheat are overloading, low voltage at motor terminals, worn bearings, failure of starting winding to "kick out," inadequate motor ventilation, high starting currents over a relatively long time, one line of a 3-phase circuit open, incorrect motor connections and electrical faults in the motor.

Each motor should be protected with an overcurrent device which will open the line contactor if an overload is sustained.

Mechanical defects which may cause overheating or overload are improper lubrication of bearings, excessive belt tension and shafts not aligned. A large percentage of motor breakdowns can be avoided by periodic inspection and early correction of faults. H. L. Mitten, Jr.

Also see abs. no. 551, 554, 559.

DAIRY PLANT MANAGEMENT AND ECONOMICS

L. C. THOMSEN, SECTION EDITOR

596. A new approach to plant planning. G. R. JOHNSON, Pace Associates, Chicago, Ill. Milk Dealer, **39,** 8: 48, 74–75. May, 1950.

To obtain adequate and efficient milk and ice cream plant facilities, determine existing requirements and estimate the rate of expansion. A basic criterion in determining whether or not to build or remodel is that of flexibility to allow for changes in production methods. Tomorrow's processing techniques may vary significantly from today's, and equipment layout and floor areas may produce different requirements. New facilities will offer definite advantages, such as efficient operation, flexibility of production techniques, ease of maintenance, tax savings and publicity value. C. J. Babcock

597. Pallet system of handling cases of milk. Anonymous. Milk Dealer, **39,** 8: 144–146. May, 1950.

The modern technique of fork-truck pallet handling of milk cases not only has saved time but has created space for storage and other essential uses, has greatly reduced the traffic congestion on the loading docks and has sharply reduced the incidence of breakage and loss of product and bottles at the Whiting Milk Co., Boston, Mass. C. J. Babcock

598. Billing method cuts statement time. Anonymous. Milk Dealer, **39,** 8: 44–45. May, 1950.

The simplified system of monthly account statements used by the Pioneer Dairy, Great Falls, Mont., is described. The advantages of the system are: (a) It gives a much nicer looking statement than does hand posting. (b) By using a posting machine and beginning to post around the 24th of the month, 1 bookkeeper can handle 1,800 accounts and do all the other plant book work. (c) By posting the total on the statement copy and not on the original, the customer receives dated statement with no evidence that it has been done at 2 times and (d) there has never been a time when statements were not out on time and without extra help.

C. J. Babcock

FEEDS AND FEEDING

W. A. KING, SECTION EDITOR

599. The absorption of vitamin A. EVA EDEN and K. C. SELLERS. Univ. of Cambridge. Biochem. J., **45,** 5: xxxiii. 1949.

Twenty cows and sheep of various ages were fed vitamin A alcohol and vitamin A ester at the rate of 5000 I.U./kg. body weight. The animals were slaughtered 4 hr. after dosing, and vitamin A alcohol and ester were determined on the intestinal contents and walls and in the lymph. Whether given in the form of ester or alcohol, the vitamin A was absorbed principally in the ester form. A. O. Call

600. The absorption of vitamin A in ruminants and rats. E. EDEN and K. C. SELLERS, Univ. of Cambridge. Biochem. J., **44,** 3: 264–267. 1949.

Vitamin A in the form of halibut liver oil was fed at a level of 5000 I.U./kg. body wt. to 16 bullocks, 19 adult sheep and 60 rats. The blood plasma vitamin A was estimated before dosing. At intervals ranging from 2–24 hr. after dosing, the animals were sacrificed and the systemic and portal blood, as well as the lymph, or lymph glands, were tested for vitamin A. In ruminants and rats vitamin A is absorbed principally through the intestinal lymph, especially in the upper part of the intestine. Portal blood (from the intestines to the liver) failed to show a significant rise. A. O. Call

601. Effect of the prepartal diet of the cow on the placental and mammary transfer of tocopherols to the calf. D. B. PARRISH, G. H. WISE, C. E. LATSCHAR and J. S. HUGHES, Kansas Agr. Expt. Sta., Manhattan. J. of Nutrition, **40,** 2: 193–202. Feb., 1950.

The tocopherol levels in the blood serum of calves from dams with and without vitamin supplements during the terminal stages of gestation were studied at birth and during the first 28 d. of life. No supplements were given following parturi-

tion. The supplements consisted of vitamin A or tocopherol or both. The tocopherol was fed daily in amounts of 0.5–1, 4, 5 or 10 g.

The prepartal supplements did not markedly affect the tocopherol levels in the serum of newborn calves before ingestion of colostrum. Tocopherol supplementation of the diet of the dams did increase the tocopherol content of the colostrum. Although there was considerable variation in individual calves, those whose dams received large tocopherol supplements had the highest serum levels of tocopherol following ingestion of colostrum. By the time calves were 28 d. of age, all calves had serum tocopherol within the same range. R. K. Waugh

602. Pyridoxine deficiency in the calf. B. C. JOHNSON, J. A. PINKOS and K. A. BURKE, Univ. of Ill., Urbana. J. of Nutrition, **40,** 2: 309–322. Feb., 1950.

Synthetic diets, with and without pyridoxine supplements, were fed to calves in order to study the requirements of calves for this vitamin. A deficiency was produced in calves fed the ration devoid of pyridoxine. Deficient calves responded to vitamin B_6 as pyridoxine, pyridoxal or pyridoxamine. The deficiency was characterized by anorexia, lack of growth, listlessness, dull and loose haircoat and, in some cases, by severe epileptiform fits and death. R. K. Waugh

Also see abs. no. 577.

HERD MANAGEMENT

H. A. HERMAN, SECTON EDITOR

603. Milking machine. H. A. MCARTHUR and J. B. DECKER (assignors to Rite-Way Products Co.). U. S. Patent 2,508,960. 11 claims. May 23, 1950. Official Gaz. U. S. Pat. Office, **634,** 4: 1241. 1950.

The milk receptacle of this pulsator-type of milker is suspended under the cow by a band running over the animal's back. Vacuum is supplied through a rubber hose. Short hoses connect the teat cups to a spout which extends from the reservoir backward under the udder. R. Whitaker

604. Milking apparatus. N. CORDIS. U. S. Patent 2,509,214. 3 claims. May 30, 1950. Official Gaz. U. S. Pat. Office, **634,** 5: 1418. 1950.

A portable unit is described which consists of of a truck holding several 10-gal. cans in an insulated compartment and a refrigerating unit for cooling milk as it is received from the milker and for keeping the cans of cooled milk cold. R. Whitaker

605. Milk weighing and recording machine. E. C. KOSTER. U. S. Patent 2,505,552. 7 claims. April 25, 1950. Official Gaz. U. S. Pat. Office, **633,** 4: 1244. 1950.

A spring type scale for weighing pails of milk after milking is equipped with a recording device which causes a pencil to move on a record sheet. The sheet is moved stepwise with each weighing. R. Whitaker

606. Pressure control valve. J. B. OLSON (assignor to James Mfg. Co.). U. S. Patent 2,506,735. 2 claims. May 9, 1950. Official Gaz. U. S. Pat. Office, **634,** 2: 449. 1950.

Water is admitted to a drinking bowl for cattle when a paddle near the bottom is depressed by the animal's nose, opening a valve. R. Whitaker

607. Calf feeding device. B. M. FRY. U. S. Patent 2,506,205. 3 claims. May 2, 1950. Official Gaz. U. S. Pat. Office, **634,** 1: 217. 1950.

A frame holds 2 troughs. In 1 a series of feeding nipples hand down and supply liquid feed to the calves. Over the other trough is a pipe with a series of holes on the top side. To wash the feeder the 1st trough is hinged to fold over the 2nd, and water is admitted to the spray pipe which flushes out the feed trough and nipples. R. Whitaker

608. Stanchion. B. SIMONSON. U. S. Patent 2,506,112. 2 claims. May 2, 1950. Official Gaz. U. S. Pat. Office, **634,** 1: 193. 1950.

A U-shaped stanchion, hinged at the bottom and attached to the floor with a swivel, is described. A cross bar, attached to a frame over the stanchion with a swivel, completes the yoke, being easily attached to the U-shaped member by means of a key. R. Whitaker

Also see abs. no. 551, 624.

ICE CREAM

C. D. DAHLE, SECTION EDITOR

609. Bulk ice cream in profit picture. W. D. DOBSON. Can. Dairy Ice Cream J., **29,** 5: 46–47, 94. May, 1950.

At the Carnation Co., bulk ice cream represents about 43% of total volume, package ice cream 31% and novelties about 26%. The gross profit on the bulk sales is slightly lower than on packaged ice cream but the difference in the margin of profit is not very great. The desire to increase the sales of bulk ice cream is not influenced adversely. There is a tendency to price bulk ice cream too low. The profit on bulk ice cream has

declined because the bulk ice cream sales have decreased. The total effect, although packaged ice cream sales have increased, has been to reduce the total volume. To increase bulk sales, the following things must be done: (a) help dealers merchandise bulk ice cream; (b) hold dealer and employee meetings and teach them how to dip bulk ice cream; (c) have dealers install separate carry-out cabinets for ice cream; (d) get the dealer, where possible, to take a lower gross margin on hand-packed ice cream to sell more product; (e) encourage sales of hand-packed ice cream. H. Pyenson

610. Article transfer mechanism. W. E. HEISE. U. S. Patent 2,509,565. 7 claims. May 30, 1950. Official Gaz. U. S. Pat. Office, **634,** 5: 1510. 1950.

Details are presented of a method of pushing frozen confection molds through a brine tank. R. Whitaker

611. Ice cream and stabilizer therefore. S. J. WERBIN (Assignor to Stein Hall & Co.). U. S. Patent 2,502,397. 6 claims. March 28, 1950. Official Gaz. U. S. Pat. Office, **632,** 4: 1234. 1950.

Ice cream mix is stabilized by guar seed gum. R. Whitaker

612. What's new in the ice cream field. G. H. WILSTER. Can. Dairy Ice Cream J., **29:** 72, 88. May, 1950.

A summary of 35 recent developments in the ice cream industry is given. H. Pyenson

Also see abs. no. 589.

MILK AND CREAM

P. H. TRACY, SECTION EDITOR

613. Change of temperature of milk in transit from the farm to the creamery. I. JENKINS, E. M. REEVE and A. L. PROVAN. J. Soc. Dairy Technol., **3,** 3: 182–186. Apr., 1950.

The increase in temperature of milk in cans during collection depended upon temperature of the milk when collected, air temperature during collection and time in transit. Under the conditions of the trials (summer) the average increase in temperature during collection and transit was approximately 2° F. for milk carried in open trucks and about 1° F. for milk in cans covered with a tarpulin. The authors conclude that, from the standpoint of preventing an increase in temperature of milk, no useful purpose is served by covering the cans. The solution, therefore, lies in using insulated vehicles. E. M. Foster

614. Milk flavors. E. G. HOOD. Can. Dairy Ice Cream J., **29,** 4: 27–30, 56. Apr., 1950.

The author discusses the off-flavors that may be found in milk, giving the 6 following causes: (a) growth of micro-organisms, (b) feed, (c) absorbed and inhalation flavors, (d) chemical composition of the milk, (e) processing and handling and (f) enzymes and catalytic changes. Only those flavor defects grouped under (b) and (d) are present in freshly-drawn milk; the others develop after milking. H. Pyenson

615. Milk bottle holder. J. G. HEUER. U. S. Patent 2,508,945. May 23, 1950. Official Gaz. U. S. Pat. Office, **634,** 4: 1237. 1950.

This holder constructed of sheet metal, for attaching to walls, is made to hold a number of milk glass bottles. The necks of the bottles are inserted in U-shaped slots in a horizontal plate. R. Whitaker

616. Cream separator. C. E. DEARDORFF. U. S. Patent reissue 23,215. 15 claims. April 4, 1950. Official Gaz. U. S. Pat. Office, **633,** 1: 85. 1950.

This device consists of a disc and a handle; it is inserted into the neck of the bottle in such a manner that the disc approximately coincides with the cream line. Cream then is removed by pouring from the top of the bottle. R. Whitaker

617. Public health milk grading a legalized illusion. J. B. BREW, Holley, N. Y. Milk Dealer, **39,** 8: 80, 92–102. May, 1950.

The history and present status of milk grading is discussed. In producing, processing, merchandising and grading milk supplies, the author advocates that the public health official concentrate on milk. Where any sanitary milk control program is aimed directly and relentlesssy at the milk itself, instead of at the barn or at the milk plant, the amount of inferior quality milk will quickly drop to, and remain at, an irreducible minimum. The dairyman who is compelled by law or other pressures to focus attention upon the details of buildings, type of milk stool, specific methods such as wiping of cows' udders before milking, and the like, is prone to think more in terms of evasions. If his attention, however, is kept upon the inherent quality of the milk he produces, he is much less inclined to take chances and will think in terms of observing those essential precautions to insure the quality of his product. C. J. Babcock

618. Apparatus for manufacturing whipped cream. F. F. Suellentrop (Assignor to Lemay Machine Co.). U. S. Patent 2,505,439. 6 claims.

April 25, 1950. Official Gaz. U. S. Pat. Office, **633,** 4: 1214. 1950.

A device for filling the head space of cans of fluid cream with a gas, such as nitrous oxide, under pressure is described. After shaking with the gas to effect solution, the cream is converted into whipped cream when released to atmospheric pressure. R. Whitaker

619. Preparation of a stabilized cream product. L. H. CHRYSLER, and E. F. ALMY (Assignors to M and R Dietetic Laboratories, Inc.). U. S. Patent 2,503,866. 27 claims. April 11, 1950. Official Gaz. U. S. Pat. Office, **633,** 2: 576. 1950.

Milk products first are subjected to a cation exchange material operating in the Na cycle. This reduces the amount of Ca to 20–70% of normal, and gives a Ca/P ratio of 1:5. The normal pH then is restored by treatment with a cation exchange material operating in the hydrogen cycle. R. Whitaker

Also see abs. no. 567, 570, 571, 572, 575, 597.

MILK SECRETION

V. R. SMITH, SECTION EDITOR

620. The intermediary metabolism of the mammary gland. 1. Respiration of lactating mammary gland slices in presence of carbohydrates. S. J. FOLLEY and T. H. FRENCH, Natl. Inst. for Research in Dairying, Reading. Biochem. J., **45,** 2: 117–125. 1949.

The respiratory metabolism of slices of mammary gland from various species was studied *in vitro*. An inverse correlation between Q_{O_2} for mammary tissue and body size is shown, being highest for the mouse and lowest for the cow. In the presence of glucose the respiratory quotient of mammary tissue from the mouse, rat, guinea pig and rabbit were greater than 1, while for ruminants (goats and cows) it was less than 1. Glucose and mannose were oxidized by lactating rat mammary gland, but galactose, lactose and fructose were not. This is in contrast to brain, retina, testis and kidney tissues which will oxidize fructose. Data are presented in 3 figures and 5 tables. A. O. Call

621. The intermediary metabolism of mammary gland. 2. Respiration and acid production of mammary tissue during pregnancy, lactation and involution in the rat. S. J. FOLLEY and T. H. FRENCH. Natl. Inst. for Research in Dairying, Reading. Biochem. J., **45,** 3: 270–275. 1949.

The respiratory quotient of rat mammary tissues in glucose is below 1 at the end of pregnancy, increases sharply at parturition and reaches a maximum of about 1.6 during lactation. Weaning brings about a decrease below 1. There is some discussion regarding the results. A. O. Call

622. The effect of thyroxine and thiouracil on some of the water-soluble vitamins in milk. (Abs.) R. CHANDA, MARY L. MCNAUGHT and E. C. OWEN. Hannah Dairy Research Inst., Kirkhill, Ayr. Biochem. J., **45,** 4: xix. 1949.

Three pairs of cows were studied for a period of 9 wk. One pair acted as a control. A second group received a 10 mg./d. subcutaneous dose of thyroxine for 3 wk. and a 3rd received 20 mg. thiouracil during the same 3-wk. test period. Thyroxine caused a decrease in phosphatase and an increase in phosphoric esters of B_1. The reverse was true when thiouracil was given. No significant differences in riboflavin were noted during treatment. A. O. Call

623. Acetic acid in bovine peripheral blood and its utilization by the mammary gland. (Abs.) G. L. MCCLYMONT, Univ. of Sydney. Biochem. J., **45,** 1: i–ii. 1949.

The volatile fatty acids of bovine arterial blood were found to be over 90% acetic with small amounts of propionic, butyric and at least 2 higher acids. Expressed on the basis of mg. acetic acid/100 ml. of blood, typical ranges for arterial blood were 8–12 mg. 2–4 hr. after feeding, 3–6 mg. 24 hr. after feeding and 1.5–3 mg. 48 hr. after feeding. Both the lactating and non-lactating mammary gland removed acetic acid from the blood, leaving from 40–80%. An association was found between the decline in Reichert value of milk fat in starvation and the fall in arteriovenous difference of acetic acid. A. O. Call

SANITATION AND CLEANSING

K. G. WECKEL, SECTION EDITOR

624. The role of the air line hose of the milking machine in the contamination of milk. E. S. CHURCHILL and W. L. MALLMANN, Mich. Agr. Expt. Sta., East Lansing. J. Milk & Food Technol., **13,** 137–145. May-June, 1950.

Bacterial counts were determined on raw milk samples, after which each sample was laboratory pasteurized at 143° F. for 30 min., cooled and plated for thermoduric count. The dirty air line tubes were examined by pouring 20 ml. of sterile skimmilk into the hose and making total and thermoduric bacterial counts. Dirty air line hose did not appreciably increase the bacterial counts in milk collected from properly sanitized milking machines. H. H. Weiser

Also see abs. no. 590.

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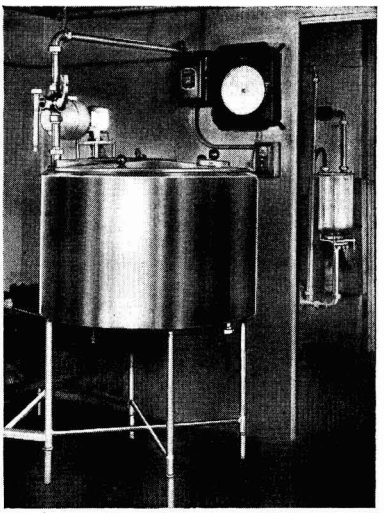

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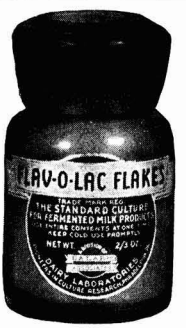

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for Plate Counts

BACTO-TRYPTONE GLUCOSE EXTRACT AGAR is recommended for routine plate counts of bacteria in milk. This medium conforms to all requirements of "Standard Methods for the Examination of Dairy Products" of the American Public Health Association, except that it does not contain skim milk.

BACTO-PROTEOSE TRYPTONE AGAR is recommended for determinations of the total bacterial plate count of certified milk. This medium is prepared according to the specifications of "Methods and Standards for Certified Milk" of the American Association of Medical Milk Commissions.

for Detection of Coliform Bacteria

BACTO-VIOLET RED BILE AGAR is widely used for direct plate counts of coliform bacteria. Upon plates of this medium accurate counts of these organisms are readily obtained.

BACTO-BRILLIANT GREEN BILE 2%

BACTO-FORMATE RICINOLEATE BROTH are very useful liquid media for detection of coliform bacteria in milk. Use of these media is approved in "Standard Methods."

for Detection of Molds

BACTO-POTATO DEXTROSE AGAR is an excellent medium for detection and enumeration of molds and yeasts in butter and other dairy products. The formula of this medium corresponds exactly with that specified in "Standard Methods."

BACTO-MALT AGAR is also widely used for determinations of the mold and yeast count of dairy products and for control of the sanitary conditions of manufacture.

for Cultivation of Lactobacilli

BACTO-TOMATO JUICE AGAR

BACTO-TRYPSIN DIGEST AGAR support luxuriant and characteristic growth of *Lactobacillus acidophilus*, and are well adapted for use in establishing the number of viable organisms in acidophilus products. These media are also widely used for estimation of the degree of implantation by *L. acidophilus*.

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