CONTENTS

JANUARY, NO. 1

Studies of the growth and blood composition of dairy calves fed remade skim milk after three days of age. L. R. ARRINGTON AND P. M. REAVES 1
The effect of penicillin upon the livability, glycolysis, and bacterial content of bovine semen. J. O. ALMQUIST, W. T. S. THORP, AND C. B. KNODT 11
The effect of conditions of storage and the viscosity of sweetened condensed milk. B. H. WEBB AND C. F. HUFNAGEL 21
Determination of cheese lipase. MERLIN H. PETERSON, MARVIN J. JOHNSON, AND WALTER V. PRICE 31
Lipase activity during making and ripening of Cheddar cheese. MERLIN H. PETERSON, MARVIN J. JOHNSON, AND WALTER V. PRICE 39
Determination of cheese proteinase. MERLIN H. PETERSON, MARVIN J. JOHNSON, AND WALTER V. PRICE 47
Proteinase content of Cheddar cheese during making and ripening. MERLIN H. PETERSON, MARVIN J. JOHNSON AND WALTER V. PRICE 55
The heritability of official type ratings and the correlation between type ratings and butterfat production of Ayrshire cows. W. J. TYLER AND GEORGE HYATT, JR. 63
Variations in type ratings of individual Ayrshire cows. GEORGE HYATT, JR., AND W. J. TYLER 71
The utilization of lactose by the dairy calf fed normal or modified milk diets. JORGE ROJAS, B. S. SCHWEIGERT, AND I. W. RUPEL 81
Association announcement 89
Abstracts of literature A1

FEBRUARY, NO. 2

The relationship of mammary development and body weight. J. R. SCHABINGER AND C. B. KNODT 95
Permanency of synthetic ascorbic acid added to milk. ARTHUR D. HOLMES AND CARLETON P. JONES 99
Sulfamethazine blood and milk concentrations in dairy cows. PETER H. LANGER, ROBERT L. BURKHART, CHARLES R. SCHROEDER, AND MARK WELSH 103
The utilization of β-carotene, vitamin A alcohol, and the natural ester of vitamin A by Holstein heifers. R. H. ROSS, C. B. KNODT, AND N. B. GUERRANT 111
Liveweight and milk-energy yield at various feeding intensities. S. D. MUSGRAVE AND W. L. GAINES 119
The chemical composition of the crystalline deposit in evaporated milk. EDGAR F. DEYSHER AND B. H. WEBB 123
The isolation and properties of the immune proteins of bovine milk and colostrum and their role in immunity: A review. EMIL L. SMITH 127
The utilization of whey: A review. BYRON H. WEBB AND EARLE O. WHITTIER 139
Abstracts of literature A17

MARCH, NO. 3

Effect of season, breed and species of ruminants on the vitamin A potency of butterfat. B. C. RAY SARKAR 165
Parturient paresis. II. The effect of partial versus complete milking upon the total blood serum calcium of dairy cows at parturition. VEARL R. SMITH, R. P. NIEDERMEIER, AND R. G. HANSEN 173
The value of hypochlorite and quaternary ammonium compounds, when used in udder washes, in reducing the plate count of milk. E. M. KESLER, G. H. WATROUS, JR., C. B. KNODT, AND P. S. WILLIAMS 179

The nutrition of the newborn dairy calf. I. Changes in the tryptophan content of the blood plasma following birth and the ingestion of colostrum. T. S. SUTTON AND G. C. ESH 183
A comparison of vacuum and steam distillation for determining the volatile acidity of evaporated milk. P. G. MILLER, P. L. ZIMMERMAN, AND E. B. OBERG 189
Curd tension test and curd number test applied to market homogenized milk in Philadelphia—definition of a soft curd milk. BERNHARD SPUR 199
Variations in yield of milk under the penkeeping system in Brazil. GERALDO G. CARNEIRO AND JAY L. LUSH 203
Abstracts of literature A27

APRIL, NO. 4

A comparative study of the biochemical activity of Streptococcus lactis, Streptococcus citrovorus, and Streptococcus paracitrovorus when grown in cow's milk and soybean milk. CHARLES W. GEHRKE AND HARRY H. WEISER 213
The role of surface-active constituents involved in the foaming of milk and certain milk products. III. Milk lipids, including phospholipids. G. A. RICHARDSON AND M. S. ELRAFEY 223
A study of multiple births in a Holstein-Friesian herd. K. O. PFAU, J. W. BARTLETT, AND C. E. SHUART 241
A study of the browning reaction in whole milk powder and ice cream mix powder. N. P. TARASSUK AND E. L. JACK 255
Iron and copper content of non-milk products commonly used in ice cream. HARRY PYENSON AND P. H. TRACY 269
The development of flavor in American Cheddar cheese made from pasteurized milk with Streptococcus faecalis starter. A. C. DAHLBERG AND F. V. KOSIKOWSKY 275
The growth and survival of Streptococcus faecalis in pasteurized milk American Cheddar cheese. F. V. KOSIKOWSKY AND A. C. DAHLBERG 285
The tyramine content of cheese. F. V. KOSIKOWSKY AND A. C. DAHLBERG 293
The relationship of the amount of tyramine and the numbers of Streptococcus faecalis to the intensity of flavor in American Cheddar cheese. A. C. DAHLBERG AND F. V. KOSIKOWSKY 305
Determination of vitamin A in milk. MELVIN HOCHBERG 315
Abstracts of literature A43

MAY, NO. 5

The effect of clipping the udders of cows on the quality of milk. E. W. HIRD, TULY REITER, K. G. WECKEL, AND N. N. ALLEN 325
Storage and treatment of milking machine inflations under farm conditions. J. M. JENSEN AND A. L. BORTREE 333
Sweet potato meal versus ground corn in the ration of dairy cows. JENNINGS B. FRYE, JR., JOHN H. THOMASON, AND HERBERT B. HENDERSON 343
Correlation between the lactose content of milk and the cerebroside and choline content of brain. D. P. SADHU 349
Estimating the amount of feed derived from pasture by cows in the Connecticut Dairy Herd Improvement Association. G. E. FRICK AND H. D. EATON 355
Effect of water sprinkling with and without air movements on cooling dairy cows. D. M. SEATH AND G. D. MILLER 363
Measurement of fluorescent materials in milk and milk products. ROBERT JENNESS AND S. T. COULTER 369
The relationship of the change in pH effected by incubation to other semen characteristics. J. T. REID, G. M. WARD, AND R. L. SALSBURY 385
Association announcements 391
Abstracts of literature A61

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VOLUME XXXI MARCH, 1948 NUMBER 3

EFFECT OF SEASON, BREED AND SPECIES OF RUMINANTS ON THE VITAMIN A POTENCY OF BUTTERFAT

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Under European and American conditions, the vitamin A potency of butter from cows generally is found to be maximum in summer and minimum in winter (3, 5, 7, 8, 9, 10, 11, 12, 13, 14, 15, 19). It also has been reported that the variation in potency is influenced but little by the stage of lactation (6, 9, 18). Since Indian climate and feeding practices vary markedly from those in Europe and America, a study of the seasonal variation in vitamin A and some of the other constituents of milk and butterfat was considered desirable.

In previous reports from this laboratory (16, 17) the effect of various levels of carotene ingestion on the vitamin A potency of milk and butterfat of Hariana cows was studied. In order to make a comparative study of the vitamin A potency of butterfat from different breeds and from other species of ruminants, further work subsequently was carried out and some of the results are presented in this paper.

EXPERIMENTAL PROCEDURE

The Institute dairy herd consisting of from 23 to 33 Hariana animals received different types of roughages, depending upon the season of the year, and a concentrate mixture (wheat bran 40 parts, gram husk 20 parts, ground nut cake 20 parts, rape cake 10 parts, and gram chuni 10 parts) at the rate of 1.5 lb. for maintenance and 1 lb. for each 2 lb. of milk produced. The animals, in addition, received 1 oz. of iodized salt and 1 oz. of bone meal per head daily.

The investigation lasted from April 1, 1941, to July 15, 1942, during which time fortnightly analyses were made to determine the carotene content of the feeds and the fat, carotene and vitamin A contents of the composite herd milk sample collected over a 3-day period from two milkings

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a day. The milk samples were analyzed also for total solids, protein, ash, calcium and phosphorus from the middle of November, 1941, until the conclusion of the experiment. Butter samples were prepared during typical drought periods (May and December) and green-feeding periods (February and July) in both winter and summer and analyzed for the Reichert-Meissl, Polenske, saponification and iodine values. The methods of analysis were the same as those previously reported (16).

To study the influence of breed and species, short-time experiments were conducted with Sahiwal heifers, goats and water buffaloes. Three Sahiwal first-calf heifers, each weighing approximately 688 lb., were fed berseem *ad libitum* in addition to the regular dairy grain mixture for a period of 19 days. The average consumption of berseem was 59 lb. and that of carotene was 1,009 mg. per day. Four goats, each having an average body weight of 67 lb., received berseem in addition to a concentrate for 18 days. The average daily consumption of berseem was 3,292 g. and the ingestion of carotene amounted to 108 mg. Two water buffaloes, each weighing approximately 865 lb., received 50 lb. of berseem daily. The level of feeding was not *ad libitum,* owing to the shortage of berseem, and the experimental period was only 11 days. The daily consumption of carotene was 785 mg. per animal. All of the milk samples used in this work were collected from two milkings a day during the last 3 days of the experimental period and analyzed for carotene, vitamin A, fat, solids-not-fat, protein and ash.

In calculating the total vitamin A potency of the butterfat, 0.6 μg. of the carotene and 0.25 μg. of the vitamin A were each taken as equal to 1 international unit of vitamin A (1).

RESULTS

Variations in vitamin A potency of butterfat. Table 1 presents the composite data for carotene, vitamin A, and total vitamin A potency of butterfat for each month of the experiment and the level of carotene ingestion for each corresponding month. In general, the maximum total vitamin A potency was reached during July, August and September (24,734 I.U. per lb.) and then diminished gradually through January. The average minimum value (16,093 I.U.) was obtained in November, December and January and then the potency began to rise, reaching the maximum value in March (24,861 I.U.). During April, May and June, the potency declined rapidly but in July the potency increased markedly. The maximum increase in total vitamin A potency was 55 per cent during the experimental period. The variations observed in total vitamin A potency were not due entirely to carotene activity or vitamin A activity alone but to a combination of both. The periodic fluctuations in carotene and vitamin A in butterfat can be correlated with the level of carotene ingestion subsequent to changing the type of fodders. On the microgram basis, the maximum and

minimum values reported in this paper are in agreement with those previously reported by Ray Sarkar and Sen (16) in experiments with cows under intensive green-feeding conditions. From the data on carotene ingestion (table 1) it has been calculated that a daily intake of about 45 lb. of average green fodder per cow will maintain the maximum vitamin A potency throughout the year (16).

TABLE 1

Seasonal variation in the vitamin A potency of butterfat of Hariana cows

Month	Av. daily carotene intake per cow	Vitamin A potency of butterfat		
		Carotene	Vitamin A	Total
(1941)	*(I.U.)*		*(I.U. per lb.)*	
April	541,800	1,582	15,155	16,737
May	521,400	1,823	16,281	18,104
June	695,500	2,291	18,844	21,135
July	990,100	2,483	22,259	24,742
Aug.	1,495,300	2,712	22,126	24,838
Sept.	1,369,600	2,833	21,790	24,623
Oct.	507,000	2,389	18,486	20,875
Nov.	260,200	1,790	14,210	16,000
Dec.	210,700	908	15,301	16,209
(1942)				
Jan.	450,400	1,269	14,802	16,071
Feb.	1,268,500	2,671	19,786	22,457
March	850,400	2,814	22,047	24,861
April	379,500	1,793	19,315	21,108
May	154,800	1,375	16,386	17,761
June	139,800	1,378	16,286	17,664
July	1,625,400	2,756	18,770	21,526

Table 2 shows the effects of carotene-poor and carotene-rich rations on the carotene and vitamin A contents and on the total vitamin A potency of butterfat of cows at different stages of lactation. The vitamin A potency of butterfat in the post-colostral period remains practically unchanged with the progress of lactation, provided the same level of carotene ingestion is maintained throughout the lactation period. This observation is in conformity with that of Treichler *et al.* (18), Gillam *et al.* (9), and Brown *et al.* (6). These results indicate that the stage of lactation has little effect on the seasonal variation in the vitamin A potency of butterfat.

Seasonal effect on the quality of butterfat. A limited number of chemical constants were determined on the butterfat samples prepared at different seasons of the year. These results are summarized in table 3. The data indicate that within the same season, the iodine values increase when green fodder is included in the ration (samples 2 and 4), whereas the Polenske values increase during the summer months (samples 3 and 4). Apparently neither the feeding of green fodder nor season had any appreciable effect on the Reichert-Meissl or saponification values. The Reichert-Meissl num-

ber, however, seems to be significantly lower and the iodine number significantly higher than that reported for western butterfat. The Polenske value tends to be lower but the saponification number is the same as that reported for western butterfat. These observations, however, are tentative and must be confirmed by future experiments.

TABLE 2

Effect of stage of lactation on carotene and vitamin A contents of the butterfat of Hariana cows

No. of cows	Month of lactation	Av. daily milk yield	Av. fat	Vitamin A potency of butterfat		
				Carotene	Vitamin A	Total
		(*lb.*)	(%)	(*I. U. per lb.*)		
Cows receiving carotene-poor rations						
5	1	12.0	5.2	785	14,876	15,661
2	2	12.5	4.8	708	14,876	15,584
5	3	11.4	4.8	785	15,242	16,027
2	4	15.5	4.7	729	14,144	14,873
3	6	9.7	5.2	652	15,775	16,427
1	7	4.0	4.5	776	15,232	16,008
	Weighted av.			748	15,066	15,814
Cows receiving carotene-rich rations						
5	3	11.8	4.5	2,712	21,660	24,372
4	4	10.3	4.5	2,349	21,717	24,066
5	5	9.0	4.4	2,590	21,548	24,138
4	6	7.5	4.9	2,692	21,484	24,176
2	7	9.0	4.9	2,481	21,412	23,893
1	8	9.0	4.5	2,242	21,791	24,033
	Weighted av.			2,566	21,594	24,160

Variations in other milk constituents. The variations in the quality of milk at various seasons as measured by differences in some of the main constituents are shown in table 4. The maximum, minimum, and average values obtained during the experimental period were 5.6, 4.5, and 4.9 per

TABLE 3

Chemical constants of the butterfat from herd milk at different seasons

Sample no.	Month	Reichert-Meissl value	Polenske value	Saponification value	Iodine value
1	Dec.	22.0	1.1	226.0	36.0
2	Feb.	23.5	1.6	226.2	40.0
3	May	24.0	2.2	227.0	37.0
4	July	23.4	2.2	226.8	39.3

cent for fat; 8.97, 8.62, and 8.75 per cent for solids-not-fat; 3.70, 3.43, and 3.53 per cent for protein; 0.808, 0.729, and 0.771 per cent for ash; 0.150, 0.125, and 0.138 per cent for calcium; and 0.107, 0.091, and 0.100 per cent for phosphorus, respectively. However, the mean fat percentage for the

15.5-month experimental period was 4.8. The fat content tended to remain at a higher level during November, December and January, when a seasonal decline in milk production occurs due to the marked drop in temperature.

TABLE 4

Composition of herd milk at different seasons of the year (Hariana cows)

Period	Fat	S.N.F.	Protein	Ash	Ca	P
(*1941*)	(%)	(%)	(%)	(%)	(%)	(%)
Nov. 16–30	5.6	8.78	3.50	0.788	0.150	0.104
Dec. 1–15	5.4	8.68	3.45	0.729	0.143	0.096
16–31	5.1	8.87	3.43	0.793	0.138	0.098
(*1942*)						
Jan. 1–15	5.2	8.97	3.70	0.778	0.138	0.103
16–31	5.2	8.84	3.61	0.778	0.148	0.097
Feb. 1–15	4.8	8.70	3.56	0.780	0.140	0.107
16–28	4.7	8.62	3.48	0.769	0.133	0.105
March 1–15	4.8	8.77	3.60	0.780	0.143	0.105
16–31	4.5	8.78	3.52	0.769	0.143	0.107
April 1–15	4.6	8.70	3.45	0.760	0.140	0.100
16–30	5.0	8.64	3.48	0.808	0.145	0.099
May 1–15	4.7	8.78	3.50	0.769	0.128	0.091
16–31	4.8	8.64	3.48	0.760	0.125	0.093
June 1–15	5.0	8.73	3.52	0.740	0.143	0.105
16–30	4.7	8.70	3.47	0.788	0.140	0.098
July 1–15	5.0	8.85	3.60	0.770	0.129	0.102
16–31	4.7	8.72	3.67	0.747	0.128	0.091
Av.	4.9	8.75	3.53	0.771	0.138	0.100

There also were differences of 20.0 and 17.6 per cent, respectively, between the lowest and highest calcium and phosphorus values. Apart from the relatively wide percentage differences in fat, calcium and phosphorus, the changes in the other constituents were slight.

TABLE 5

The various constituents in milk and the carotene and vitamin A contents of butterfat from heifers, goats and buffaloes

	Heifers	Goats	Buffaloes
Milk yield	10.6 lb.	383.5 ml.	16.2 lb.
Fat (%)	6.5	5.1	7.9
S.N.F. (%)	8.59	9.28	9.90
Protein (%)	3.73	4.54	4.03
Ash (%)	0.750	0.897	0.856
Carotene (I.U.)[a]	2,782	Trace	Trace
Vitamin A (I.U.)[a]	23,050	26,498	17,879
Total potency (I.U.)[a]	25,832	.....	.....

[a] Per lb. of butterfat.

Constituents in milk and butterfat of heifers, goats and buffaloes. The data pertaining to the amounts of various constituents in milk and the carotene and vitamin A in butterfat from the three species are shown in table 5. Although the number of animals is small, it may be said that the

various species do differ in regard to the secretion of the various constituents in milk. This observation is not new. The interesting fact is the trace of carotene in the butterfat from goats and buffaloes, an amount which is not measurable quantitatively by the usual colorimetric method. Considerable individual variation in the vitamin A content also was noted in the case of each species. So far as total vitamin A potency of butterfat is concerned, goats and cows are almost equally efficient. It was observed subsequently in the case of the goats that the same potency could be attained even at a level of 60 per cent of the original carotene ingestion. The vitamin A potency of the butterfat of the buffalo was comparatively low. A true comparison could not be made because the level of carotene ingestion was not high enough owing to the shortage of green fodder. Subsequent studies with other animals under heavy green-fodder feeding have shown, however, that buffalo butterfat might contain as much as 20,480 I.U. per lb. as compared to 25,000–26,000 I.U. in the case of butterfat from cows and goats.

A comparison of the figures previously obtained for carotene and vitamin A in the butterfat from Hariana cows shows that the vitamin A potency is the same for the Sahiwal and Hariana breeds (16) when calculated on the same basis. The concentration of vitamin A in the butterfat of cows so far examined compares fairly well with that found for some western breeds (2, 4, 9), but the picture is different with respect to carotene. The two Indian breeds studied so far definitely secrete less carotene in butterfat. It is difficult to say without further experimentation where this physiological difference lies. In view of the lack of knowledge regarding the fate of carotene in the rumen, much importance has not been given to the value of about 70 per cent apparent fecal excretion in the case of cows and goats, as determined incidentally. If the rest of the carotene were absorbed, then the recovery of absorbed carotene as carotene and vitamin A in milk would amount to about 3.5 per cent. This value is practically the same for the heifers and goats under comparable feeding conditions. There is very little carotene in the plasma of goats as compared to 0.891 mg. per cent in the plasma of the Sahiwal heifers. On the other hand, the blood plasma levels of vitamin A were 0.170 mg. and 0.157 mg. per cent, respectively, for heifers and for goats. Buffalo blood was not examined in this connection. Goats and buffaloes possibly convert more of the absorbed carotene into vitamin A, which is readily transmitted into the milk.

SUMMARY

The seasonal variations in vitamin A potency of butterfat and other consituents in herd milk of Hariana cows have been investigated. The vitamin A potency varied with the level of carotene intake. The potency was maximal in the monsoon periods (July, August and September) when the cows were getting sufficient carotene from grazing and again during the

winter months (February and March) when large quantities of cultivated fodders were available. The average maximum total potency approximated 24,972 I.U. per lb., of which 2,700 I.U. were due to carotene. The average minimum potency of 16,093 I.U., of which 1,322 I.U. were due to carotene, was obtained in November, December and January, when very little green feed was available. The maximum variations in carotene, vitamin A, and total vitamin A potency were 212.0, 56.6, and 55.0 per cent, respectively. The vitamin A potency was not influenced by the stage of lactation.

Except for fat content, which was about 25 per cent higher in November, December and January, and for calcium and phosphorus, the solids-not-fat, protein and ash content of the milk remained unchanged throughout the experimental period.

The Polenske values of the butterfat were higher in summer than in winter but the Reichert-Meissl and saponification values did not show any seasonal change. The saponification value was the same as that reported in the literature for American butterfat, but the Reichert-Meissl number was approximately 20 per cent lower and the iodine number was about 10 per cent higher. The inclusion of green feed in the ration tended to increase the iodine value.

There was practically no difference in the carotene and vitamin A contents of butterfat from the cows of the Hariana and Sahiwal breeds. Although butterfat from goats contained only traces of carotene, the vitamin A content was as high as the total potency in the butterfat from cows. Buffalo butterfat examined in this investigation resembled that of goats in respect to carotene, but the vitamin A content was comparatively low.

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PARTURIENT PARESIS. II. THE EFFECT OF PARTIAL VERSUS COMPLETE MILKING UPON THE TOTAL BLOOD SERUM CALCIUM OF DAIRY COWS AT PARTURITION[1]

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A common practice among dairymen is to partially milk cows for a few days following parturition, because it is believed to reduce the incidence of parturient paresis or milk fever. Several workers (2, 3, 6) have demonstrated that air inflation of the udders of cows with parturient paresis results in an increase in the total serum calcium and generally brings about recovery. When air pressures equal to 25 to 40 mm. Hg were maintained in the udder, inhibition of milk secretion was almost complete (4, 5). The efficacy of the air inflation treatment for parturient paresis has been attributed to resorption of milk or cessation of milk secretion caused by increased intramammary pressure, thereby preventing a further uptake of calcium by the mammary gland. As a result of these studies, the belief has become prevalent that the incidence of parturient paresis could be lowered if some milk was left in the udder to maintain pressure. This study was undertaken to learn the effect of complete milking immediately following parturition upon the incidence of parturient paresis and total blood serum calcium.

EXPERIMENTAL PROCEDURE

Cows used were of the Holstein, Guernsey and Jersey breeds. They were divided into two groups by alternating cows within each breed. The cows in the partially milked group were managed in the conventional manner by permitting the calves to remain with the cows for 3 days following calving. About two-thirds of the milk was removed from the udders of this group beginning the day after calving. Complete milking began the fourth day subsequent to calving.

Calves were removed from the dams in the completely milked group before nursing, and the cows were milked completely with the aid of an intravenous injection of 10 I.U. of oxytocin from 1 to 3 hours after calving. The cows then went on the regular two-time milking schedule and were in-

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TABLE 1

Daily levels of total blood serum before and after parturition

Cow no.	Total blood serum calcium—mg.%											Date of parturition	Remarks
	Days prepartum					Day of parturition	Days postpartum						
	5	4	3	2	1		1	2	3	4	5		
Jerseys (completely milked group)													
711	.....	.....	.....	.....	10.9	9.9	—[a]	9.5	10.4	10.0	10.3	6–13–45	.....
703	10.1	11.2	10.9	10.2	10.6	9.6	6.0	8.1	9.5	8.7	9.5	6–23–45	Mild symptoms of milk fever
667	.....	9.4	9.8	9.8	9.7	5.9	7.9	10.6	10.3	10.3	–	6–27–45	.....
713	9.5	9.6	9.4	9.3	8.1	7.6	9.0	9.7	10.2	10.3	10.4	8–25–45	.....
B61	.....	.....	9.8	9.9	9.5	5.0	5.8	8.5	9.0	9.5	9.3	2–22–46	Mild symptoms of milk fever
B58	.....	.....	.....	9.9	9.1	4.0	5.6	3.7	7.9	9.9	10.1	3–21–46	Milk fever on 3–21–46
705	.....	.....	10.0	9.9	9.8	6.8	6.3	7.0	7.2	9.4	9.9	8– 3–46	.....
696	10.2	9.9	9.9	10.4	10.2	6.1	4.1	8.4	9.0	9.5	10.2	9–15–46	Milk fever on 9–16–46
731	.....	.....	10.7	10.4	10.1	9.7	10.1	10.4	10.6	–	–	9–23–46	.....
729	10.7	10.8	10.8	10.0	10.5	9.7	10.1	10.8	10.8	–	–	11–22–46	.....
B57	9.8	10.4	10.2	10.1	–	8.4[b]	10.9	7.6	8.0	9.6	8.9	4–14–47	Milk fever on 4–14–47
Jerseys (partially milked group)													
705	9.9	10.2	10.1	10.4	11.3	8.2	4.2	6.4	8.2	9.3	10.3	6–26–45	Milk fever on 6–27–45
671	10.0	10.6	10.2	10.2	9.3	7.4	4.7	7.6	14.4[b]	–	–	8–20–45	Milk fever 8–21–45, died 8–23–45
690	.....	.....	11.3	10.3	10.6	4.4	6.6	10.9	11.4	11.6	–	10– 5–45	Milk fever on 10–5–45
731	10.5	9.2	11.6	10.6	10.9	10.3	10.3	10.2	10.6	10.6	10.4	10–22–45	.....
B57	.....	.....	.....	.....	9.3	6.0	4.1	7.2	10.4	11.3	11.6	12– 2–45	Milk fever on 12–3–45
B63	.....	.....	.....	.....	9.2	4.7	7.8	11.2	10.7	10.9	–	3–24–46	Milk fever on 3–24–46
711	9.7	9.7	10.2	9.8	9.8	8.4	7.6	9.6	10.3	10.9	10.7	8– 8–46	.....
713	.....	.....	.....	.....	9.8	–	8.7	8.5	5.9	6.1	7.9	8–31–46	Milk fever 8–31–46, died 9–18–46
703	10.2	10.7	10.9	10.7	8.5	4.0	8.0	10.8	10.4	10.6	10.2	9–15–46	Milk fever on 9–15–46
720	.....	.....	.....	10.5	8.4	6.7	9.6	10.4	10.7	10.7	–	12– 9–46	.....
B61	.....	.....	10.4	10.8	10.3	4.9	6.1	7.5	10.8	10.2	10.0	4–10–47	Milk fever on 4–10–47

[a] Either blood sample was not drawn or was destroyed accidentally.
[b] Treated for milk fever before blood sample was taken.

jected intravenously with oxytocin at each milking for 5 days subsequent to calving.

TABLE 2

Average total blood serum calcium

	Total blood serum calcium—mg. %											Remarks
	Days prepartum					Day of parturition	Days postpartum					
	5	4	3	2	1		1	2	3	4	5	
Jerseys												
Completely milked group												
Av. 11 cows	10.1	10.2	10.2	10.0	9.9	7.5	7.6	8.6	9.4	9.7	9.8	3 cases milk fever
Partially milked group												
Av. 11 cows	10.1	10.1	10.7	10.4	9.8	6.5	7.1	9.1	10.3	10.2	10.2	8 cases milk fever
Both groups												
Av. 22 cows	10.1	10.2	10.4	10.2	9.8	7.0	7.3	8.8	9.8	10.0	10.0	11 cases milk fever
Guernseys												
Completely milked group												
Av. 9 cows	10.3	10.3	10.2	10.4	10.1	8.8	9.2	9.7	9.6	10.0	10.1	
Partially milked group												
Av. 11 cows	9.9	10.4	10.2	10.0	9.9	9.0	9.3	9.4	9.9	9.8	10.0	
Both groups												
Av. 20 cows	10.1	10.3	10.2	10.2	10.0	8.9	9.3	9.5	9.8	9.9	10.0	
Holsteins												
Completely milked group												
Av. 7 cows	10.1	10.5	10.4	10.5	9.8	9.0	8.4	9.3	10.1	9.8	10.3	
Partially milked group												
Av. 7 cows	11.1	10.2	10.5	10.3	10.1	9.5	9.7	9.9	9.9	10.2	9.9	
Both groups												
Av. 14 cows	10.4	10.4	10.5	10.4	10.0	9.2	9.1	9.6	10.0	10.0	10.1	
Summary of all breeds												
Av. 27 completely milked cows	10.2	10.3	10.2	10.3	9.9	8.3	8.4	9.1	9.6	9.8	10.0	3 cases milk fever
Av. 29 partially milked cows	10.2	10.2	10.4	10.2	9.9	8.2	8.5	9.4	10.1	10.1	10.0	8 cases milk fever

Venous blood samples were taken daily for 5 days previous to the anticipated day of parturition and for the first 5 days subsequent to calving. Blood samples were drawn within an hour of the same time daily. Total

blood serum calcium was determined by a modification of the Clark-Collip method (1).

The experiment ran from June, 1945, until May, 1947, and included a total of 56 cows, of which 29 were in the partially milked group and 27 in the completely milked group. All cows of the three breeds mentioned freshening in the experimental herd were included, with the exception of first-calf heifers, which rarely if ever have parturient paresis.

A case was not diagnosed as parturient paresis or milk fever unless the cow was "down" or in a coma with typical symptoms. Two cows in the completely milked group showed mild symptoms of milk fever but never went "down" and recovered without treatment.

RESULTS

Data for the Jerseys of both groups are presented in table 1. The average figures of total blood serum calcium for both groups of all breeds, as well as a summary of all breeds, are presented in table 2. The complete data for the other breeds are not presented, as all cases of milk fever occurred within the Jersey breed. The over-all incidence of the disease was 19.6 per cent, with eight cases of milk fever occurring in the partially milked group and three cases in the completely milked group. The Jersey breed had an incidence of 50 per cent, with 27.3 per cent in the completely milked group and 72.7 per cent in the partially milked group. Two of the Jersey cows (671 and 713, while in the partially milked group) died, although calcium treatment was administered. Cow no. 713 developed a case of severe ketosis, for which treatment proved ineffective, and this was the ultimate cause of her death.

Total blood serum calcium levels exhibited a characteristic drop on the day of calving, with a gradual return to normal by the fourth or fifth day subsequent to calving. The greatest drop was evident in the Jersey breed, with little difference in the averages of the Holstein and Guernsey breeds. The total blood serum calcium levels of the two groups closely parallel each other.

SUMMARY

The complete milking of cows immediately following parturition did not increase the incidence of parturient paresis or was the average total serum calcium greatly different for the two groups.

Determinations for total blood serum calcium were made on samples of blood collected daily from 27 cows of the completely milked group and 29 cows of the partially milked group for 5 days prior to the anticipated day of parturition and for 5 days following calving.

Two cows showed mild symptoms and three had parturient paresis in the completely milked group. Eight cows in the partially milked group had

parturient paresis. All cases of parturient paresis occurred in the Jersey breed.

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THE VALUE OF HYPOCHLORITE AND QUATERNARY AMMONIUM COMPOUNDS, WHEN USED IN UDDER WASHES, IN REDUCING THE PLATE COUNT OF MILK[1,2]

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Various bactericidal agents now are in general use in solutions for washing the udders of cows prior to milking. Comparatively little information is recorded regarding their value in reducing the plate count of the milk produced. Scales and Kemp (6) reported that 2 minutes was too short a period for chlorine to yield dependable sterility. Other workers, Bryan *et al.* (2) and Waugh *et al.* (9), have shown that no viable organisms were present in recommended concentrations of chlorine. Spurgeon *et al.* (8) compared the bactericidal activity of hypochlorites and quaternary ammonium compounds. When applied to teats which had been inoculated with a suspension of *Streptococcus agalactiae,* these germicidal solutions did not eliminate all the organisms present but did destroy 90 per cent of those that would have remained after ordinary rinsing of teats with non-germicidal solutions. Mueller *et al.* (5) found that approximately 0.3 per cent of cow feces or nonfat milk solids produced a significant decrease in germicidal potency of a 200 p.p.m. quaternary ammonium solution. Keith and Reaves (4) washed udders with quaternary ammonium compounds, chlorine, and plain water. They believe the quaternary ammonium compounds are effective sanitizing agents. Byers and Ewalt (3) reported a reduction of 34.2 per cent in the plate count of milk produced when the udders of cows were washed with chlorine solutions.

Definite information relative to the value of solutions of these substances in washing the udders of dairy cows previous to milking apparently is needed.

EXPERIMENTAL PROCEDURE

Four groups of five cows, each as similar as possible on the basis of level of milk production, age, and stage of lactation, were selected. All were fed and managed alike. Their udders were washed with clean water preparations as follows: Water alone, 200 p.p.m. chlorine, 400 p.p.m. chlorine, 200 p.p.m. quaternary ammonium compound, and 400 p.p.m. quaternary am-

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[1] The experimental data in this paper are taken from a thesis presented by E. M. Kesler in partial fulfillment of the requirements for the degree of Master of Science in Dairy Husbandry, Pennsylvania State College.

[2] Authorized for publication October 31, 1947, as paper no. 1402 in the Journal Series of the Pennsylvania Agricultural Experiment Station.

monium compound. A generally used commercial sodium hypochlorite powder was used for preparing the chlorine solution. Similarly, a widely used commercial preparation containing 10 per cent alkyl-dimethyl benzyl-ammonium chlorides of high molecular weight was used as a source of quaternary ammonium compounds. Two gallons of each of these solutions were prepared at a temperature of 125° F. just prior to milking, using amounts of the bactericides in accordance with manufacturers' directions. A clean turkish towel was used for each solution. Washing was done throughout by the same person. The udder and flanks of the cow were scrubbed thoroughly with the towel, which had been removed from the solution and folded wet. The cloth then was rinsed in the solution, wrung dry, and used to wipe the udder. Only one cow was washed with each water preparation. Two streams of milk were removed from each teat into a strip cup. The milking machines were attached 1 minute after the washing was begun.

Previous to each milking time the milking machines were taken apart and scrubbed thoroughly with a detergent. They then were rinsed in clear, warm water, reassembled, and the complete unit autoclaved at 15 lb. pressure for 20 minutes. Before autoclaving, each teat cup was covered with paper foil which was not removed until the machine was to be attached to the udder. Milking was done by the same persons and at the same time each evening. All five cows were milked simultaneously. Each cow was milked dry and machine stripped only.

When the machine was removed from the cow, a sample of the milk was obtained from the pail with a sterile milk thief and placed in a sterile sample bottle. The samples were iced until plated. They were transported to the laboratory and plated on tryptone-glucose-extract-milk agar within 0.5 hour. Plating and counting were done according to Standard Methods for the Examination of Dairy Products (1). This procedure was repeated 5 days with treatments randomized in a Latin square design so that no cow received the same treatment more than once. Use of the five machines was randomized so that the same machine was used only once on each cow and only once with each treatment during the individual trial.

A separate Latin square design and different cows were used for each of the first four trials. This experiment was conducted on only the evening milking. During the last period, it seemed desirable to determine the difference in response, if any, between evening and morning milking. This will be designated as Trial V, which followed the same Latin square design and used the same cows as Trial IV and was run on the mornings of the same days.

RESULTS

During the course of Trial I, one cow suffered an attack of acute mastitis. In 2 days, the bacteria per ml. in her milk increased from around 1,000 to

70,000. On two occasions the milker allowed the teat cups to touch the bedding as he was attaching the machine. This resulted in visible sawdust in the milk and exceptionally high plate counts. The results on this trial are shown in table 1. An analysis of variance run on the data showed no significant difference between treatments, possibly due to the small number of observations.

TABLE 1

The plate counts of milk obtained in trial I[a]

Cow no.	Day 1	Day 2	Day 3	Day 4	Day 5
1	Quat. ammonium 200 p.p.m. 760	Chlorine 400 p.p.m. 740	Chlorine 200 p.p.m. 610	Quat. ammonium 400 p.p.m. 1,300	Water 1,700
2	Chlorine 200 p.p.m. 1,100	Quat. ammonium 400 p.p.m. 1,000	Chlorine 400 p.p.m. 9,800[b]	Water 1,000	Quat. ammonium 200 p.p.m. 70,000[b]
3	Water 540	Chlorine 200 p.p.m. 740	Quat. ammonium 200 p.p.m. 1,900	Chlorine 400 p.p.m. 1,500	Quat. ammonium 400 p.p.m. 650
4	Chlorine 400 p.p.m. 1,700	Water 1,100	Quat. ammonium 400 p.p.m. 510	Quat. ammonium 200 p.p.m. 1,600	Chlorine 200 p.p.m. 840
5	Quat. ammonium 400 p.p.m. 1,900	Quat. ammonium 200 p.p.m. 2,000	Water 92,000[c]	Chlorine 200 p.p.m. 60,000[c]	Chlorine 400 p.p.m. 1,100

[a] Expressed as bacteria per ml.
[b] Mastitis.
[c] Teat cup touched bedding.

Trials II, III, IV and V were run with no further occurrence of contamination. Data for the five trials are shown in table 2. The mean figures shown for Trial I exclude the four instances when the count was high due to uncontrolled influences.

TABLE 2

The effect of hypochlorite and quaternary ammonium solutions, when used in udder washes, upon the plate count of milk[a]

Trial no.	Chlorine 200 p.p.m.	Chlorine 400 p.p.m.	Quarternary ammonium 200 p.p.m.	Quarternary ammonium 400 p.p.m.	Water
I	823[b]	1,260[b]	1,565[b]	1,072	1,085[b]
II	2,208	2,370	2,812	2,756	1,946
III	1,438	1,372	930	1,448	1,528
IV	2,461	1,109	2,176	1,198	2,174
V	5,821	2,170	2,234	1,180	1,390
Mean	2,550	1,656	1,943	1,531	1,625

[a] Mean of 5 observations on each treatment expressed as bacteria per ml.
[b] Mean of 4 observations.

An analysis of variance was run on Trials II, III and IV, which represent the trials on evening milkings with no data missing. No significant difference in treatments could be observed. There was a highly significant difference between cows.

An analysis then was run on all five trials, using the missing data technique (7) for Trial I. Again there was no statistically significant difference between treatments. The variations due to cows were highly significant.

A comparison of the evening and morning counts between Trials IV and V was made. The mean count for the 25 morning observations was 2,559 bacteria per ml.; for the corresponding evening counts the mean was 1,824. This difference was not statistically significant.

SUMMARY AND CONCLUSIONS

The effect of various udder washes upon the plate count of milk was studied using two concentrations of chlorine, two concentrations of quaternary ammonium, and clean water. Milking was done with previously autoclaved milking machines and the raw milk plated on tryptone-glucose-extract-milk agar before growth could take place. No differences in count could be attributed to treatments. A large degree of variation was observed between individual cows. On 25 pairs of observations, no significant difference in counts could be observed between night and morning milkings.

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THE NUTRITION OF THE NEWBORN DAIRY CALF. I. CHANGES IN THE TRYPTOPHAN CONTENT OF THE BLOOD PLASMA FOLLOWING BIRTH AND THE INGESTION OF COLOSTRUM

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Recent work at the University of Illinois (6) has shown that calves do not require a dietary source of nicotinic acid when fed a nicotinic acid-free synthetic milk. These calves were placed on a synthetic milk diet after receiving colostrum for 48 hours and were continued on the experimental diet for 12 weeks. A study of the urinary excretion of nicotinic acid and its metabolic products, nicotinamide, nicotinuric acid and N^1-methylnicotinamide, showed that the total excretion dropped rapidly following colostrum feeding, and then remained at a fairly constant level throughout the remainder of the experimental period.

Contemporary work (7, 9, 10) has provided evidence that tryptophan is the precursor used in the *in vivo* synthesis of nicotinic acid. The relatively high blood plasma nicotinic acid values observed following a 48-hour colostrum-feeding period by the Illinois workers (6), plus the fact that other workers (8) have reported rather low nicotinic acid values for cows' colostrum, suggest the desirability of studying the tryptophan content of colostrum and the changes which occur in plasma concentration following colostrum feeding.

A review of the literature revealed no information on the concentration of tryptophan in colostrum or in newborn calf blood plasma. However, it is known that the proteins of milk are relatively well supplied with this essential amino acid. Data in the literature show 0.31 to 0.32 per cent of tryptophan in whole milk powder (3), from 1.09 to 1.31 per cent of tryptophan in casein (2, 3, 4, 5, 11), and from 1.74 to 2.66 per cent tryptophan in lactalbumin (2, 3, 4, 5). The nature and concentration of proteins in cows' colostrum suggest that it should supply an abundance of tryptophan for the nutrition of the newborn calf.

EXPERIMENTAL PROCEDURE

Tryptophan determinations were made on the first- and second-milking colostrum from 10 cows and on the blood plasma of 13 calves at the time

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[1] A graduate student at The Ohio State University supported by the Government of India.

of birth and on the third, seventh, and fourteenth day following birth. Determinations also were made on the blood plasma of 10 of these calves on the twenty-first day following birth. These calves all were born in the Ohio State University Dairy Herd during August and September, 1947. Tryptophan determinations also were made on the whole milk and blood plasma of 15 cows for comparison. Samples of the colostrum as well as of the milk were taken from the complete milking.

The *p*-dimethylaminobenzaldehyde method of Bates (1) as modified by Graham *et al.* (2) was employed for tryptophan estimation. An Evelyn photoelectric colorimeter with a 550-mμ filter was used. The K value was obtained by carrying out the procedure with known quantities of *l*-tryptophan[2] and checked with known quantities of *d-l*-tryptophan.[3]

RESULTS

The analytical data obtained are presented in the tables. It will be noted that the tryptophan level in blood plasma is quite low in the newborn calf, averaging 0.46 mg. per g., wet basis (table 1). In every instance there

TABLE 1

Changes in the blood plasma tryptophan of calves following birth

Calf no.[a]	Blood plasma tryptophan				
	Age in days				
	0[b]	3	7	14	21
	(*mg./g.*)[c]				
42S	0.46	1.05	1.10	1.04	0.86
41S	0.46	0.99	1.05	0.84	0.75
503H	0.47	1.16	1.16	0.99	0.82
43S	0.43	0.55	0.65	0.62	.....
355A	0.56	1.28	1.01	0.92	0.96
357A	0.75	1.43	1.53	1.43	1.12
329G	0.41	0.71	0.74	0.66	0.64
330G	0.41	0.81	0.84	0.91	0.55
331G	0.45	0.87	0.82	0.70	0.81
332G	0.44	0.95	0.77	0.47	0.89
272J	0.40	0.98	0.86	0.76	0.76
373J	0.48	0.70	0.91	0.76	.....
507H	0.34	0.81	1.14	1.09	.....
Av.	**0.46**	**0.94**	**0.96**	**0.86**	**0.81**

[a] The letter following the number designates breed: S = Brown Swiss, H = Holstein, A = Aryshire, G = Guernsey, J = Jersey.

[b] These samples all were taken before the first feeding of colostrum.

[c] Wet basis.

was a marked increase during the first 3 days, and the average on the third day was approximately double that of the newborn calf. The highest aver-

[2] Supplied through the courtesy of Dr. F. E. Deatherage, Department of Agricultural Chemistry.

[3] Supplied through the courtesy of Merck and Co., Rahway, New Jersey.

age level was observed on the seventh day, following which there was a slight decline. At no time during the first 21 days was a level attained which was as high as that of the adult cow, although in a few instances on the third, seventh, and fourteenth days values were recorded which were within the range found for adult cows, as shown in table 2.

TABLE 2

Tryptophan content of blood plasma and milk of dairy cows

Cow no.[a]	Lactation no.	Days in milk	Blood plasma tryptophan	Milk tryptophan
			(*mg./g.*)[b]	(*mg./g.*)[b]
191A	10	44	1.54	0.78
214A	10	146	1.80	0.82
269A	4	35	1.38	0.62
410H	3	75	1.54	0.71
433H	2	218	1.20	0.73
460H	1	13	1.20	0.68
277G	3	28	1.02	0.70
221G	6	250	1.55	0.84
275G	2	16	1.39	0.78
19S	1	69	1.20	0.69
11S	3	236	1.53	0.81
7S	9	39	1.51	0.75
335J	1	17	1.12	0.82
337J	1	48	1.60	0.75
325J	2	48	1.20	0.87
Av.	.....	.....	**1.38**	**0.75**

[a] The letter following the number designates breed: A = Ayrshire, H = Holstein, G = Guernsey, S = Brown Swiss, J = Jersey.

[b] Wet basis.

Table 3 shows colostrum to be a rich source of tryptophan. On a wet basis, first-milking colostrum contains about five times as much as normal milk. Second-milking colostrum is about three times as high in tryptophan as normal milk. One pound of average first-milking colostrum would provide approximately 1.74 g. of tryptophan, while a pound of normal milk would supply only about 0.34 g.

The tryptophan content of a 20-lb. lot of fat-free moisture-free colostrum which had been obtained from the first and second milkings of several cows was compared with that of samples of spray-dried and drum-dried commercial nonfat-dry-milk solids. Analyses of these materials gave results of 13.5, 7.9, and 7.7 mg. of tryptophan per g. for the dry colostrum, the spray-dried powder, and the drum-dried powder, respectively. These results are in agreement with what one might expect, since a greater proportion of the nonfat solids of colostrum is protein and a greater proportion of the protein of colostrum consists of fractions which are somewhat higher in tryptophan than casein.

These results suggest that the high excretion rate of nicotinic acid and its metabolic products found by the Illinois workers (6) may have resulted

from the high tryptophan consumption during the first 48 hours. It seems logical to assume that nicotinic acid synthesis in the very young calf must be dependent upon some dietary precursor since microbiological synthesis

TABLE 3

Tryptophan content of colostrum

Cow no.[a]	Tryptophan	
	1st milking	2nd milking
	(*mg./g.*)[b]	(*mg./g.*)[b]
373A	4.61	3.15
265A	4.60	2.42
191A	4.62	3.26
269A	5.94	3.93
273H	4.32	3.55
464H	2.82	2.30
460H	4.90	3.16
337J	1.42	1.05
281G	3.15	1.75
277G	2.16	1.20
Av.	**3.85**	**2.57**

[a] The letter following the number designates breed: A = Ayrshire, H = Holstein, J = Jersey, G = Guernsey.

[b] Wet basis.

in the rumen is a doubtful source of this nutrient at so early an age. On the other hand, it may be that a relationship exists between trytophan and nicotinic acid similar to that known to occur between methionine and choline.

A study of the effects of colostrum consumption on the excretion of nicotinic acid and its precursors is being contemplated.

SUMMARY

A study of the tryptophan content of the blood plasma of calves showed average values of 0.46, 0.94, 0.96, 0.86, and 0.81 mg. per g. wet basis for the newborn calf and at 3, 7, 14 and 21 days of age, respectively.

The amount of tryptophan in first-milking colostrum was found to be about five times as high and that of the second milking about three times as high as that of normal milk.

These results are discussed in the light of tryptophan being the possible precursor for the *in vivo* synthesis of nicotinic acid.

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A COMPARISON OF VACUUM AND STEAM DISTILLATION FOR DETERMINING THE VOLATILE ACIDITY OF EVAPORATED MILK

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The acidity and changes in acidity of milk are known to be of importance in milk processing and storage. Many workers have shown that heat causes the formation of acids in milk. As early as 1895 Cazeneuve and Haddon (2) reported that the acid formed by heating was mainly formic acid. This view is in accordance with the recent work of Gould (7) and Gould and Frantz (8). Since most workers report the chief volatile acid produced by heating milk to be formic, the importance of other volatile acids appears questionable.

The use of steam distillation for removing volatile acids from sterilized evaporated milk may or may not be the best procedure. Destruction of milk constituents during steam distillation is indicated by a marked browning of the milk and liberation of volatile sulfides (at proper pH). Although reports show that the steam distillation of raw skim milk or whole milk resulted in the formation of no appreciable amount of formic acid, (7, 8) this does not show what steam distillation may do to heated milk. Also, volatile acids other than formic possibly may be affected. For instance, glycerides of lower fatty acids may be split during the steam distillation of milk.

The use of vacuum distillation in removing volatile constituents from foods has been suggested by Fischbach (5) and has been used successfully by other workers. Vacuum distillation seemed to be a logical method for removing the volatile acids from milk without the use of excessive heating. This investigation was concerned with a comparison of vacuum distillation and steam distillation as a means of studying formic and total volatile acids in heated milk.

EXPERIMENTAL PROCEDURE

Vacuum distillation. The distilling setup consisted of pryex ground-joint equipment. Essential pieces were a 3-l. round-bottom distillation flask, a 300-mm. spiral (Graham) condenser, a 1-l. receiving flask, and suitable connecting tubes and adapters. Constant pressure was maintained by means of a Cartesian diver-type manostat (6).

In the vacuum method finally adopted 500 ml. of reconstituted milk (1 part evaporated milk to 1.2 parts water) was acidified to pH 1.5 (approximately) by running in 100 ml. of *N* sulfuric acid while the milk

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was being agitated with a mechanical stirrer. The acidified milk was distilled at a pressure of 24 mm. mercury and at a rate of approximately 400 ml./hr. The boiling temperature was 24–25° C. The volume of the distilland was maintained constant by running boiled distilled water, from a calibrated flask protected by a soda-lime tube, into the distilling flask through a glass tube and stopcock arrangement, and checking the volume of water run in against the volume of distillate.

For the determination of total volatile acids, 600 ml. of distillate was collected and titrated under nitrogen to phenolphthalein with 0.1 *N* sodium hydroxide. A blank correction of 0.09 ml. of 0.1 *N* sodium hydroxide for the amount of alkali required to change the indicator in 600 ml. of boiled distilled water was deducted from the titration. Total volatile acids in the distillate were calculated as formic acid.

For the determination of formic acid the entire distillate then was concentrated to about 100 ml. by boiling with 200 ml. of 1 per cent barium carbonate suspension. The barium carbonate was filtered off and the formic acid determined by the A.O.A.C. gravimetric procedure (1).

Steam distillation. The apparatus for steam distillation was essentially the same as that used for vacuum distillation except for the necessary provision for a steam generator and a soda-lime tube connected to the receiving flask outlet in place of vacuum equipment.

The distillation procedure was similar to the vacuum distillation except for the use of steam at atmospheric pressure and the acidification of the diluted evaporated milk sample. The diluted sample was acidified in this case with only 80 ml. of *N* sulfuric acid and 20 ml. of water to lower the pH to approximately 2.0 (as against pH 1.5 and a much lower temperature with the vacuum method).

The steam distillation procedure differed from that used by Gould and Frantz (8) and Gould *et al.* (9) in the following details: (a) In the present work the size of the sample was doubled. (b) Volatile acids were collected in the distillate rather than in a barium carbonate trap. (c) The ratio of distillate to distilland was 1 : 1 instead of 3.33 : 1.

Total volatile acids and formic acid in the steam distillate were determined by the procedure employed with the vacuum distillate.

RESULTS

Distillation curves. Calculation of formic acid and total volatile acids in the milk was based on distillation curves of formic acid determined in the particular apparatus used. The curves presented in figure 1 were plotted from data obtained by distilling dilute aqueous solutions of pure formic, *n*-butyric, and caproic acids under the same conditions and in the same apparatus used in distilling milk samples. The method of plotting on inverted semi-log paper was copied after Dyer (4). Actually, the log of

the percentage of volatile acid remaining in the distilland was plotted against total volume of distillate collected, giving a straight line. However, since the main purpose of the figure is to show the per cent of acid recovered in the distillate, the data were plotted on inverted semi-log paper.

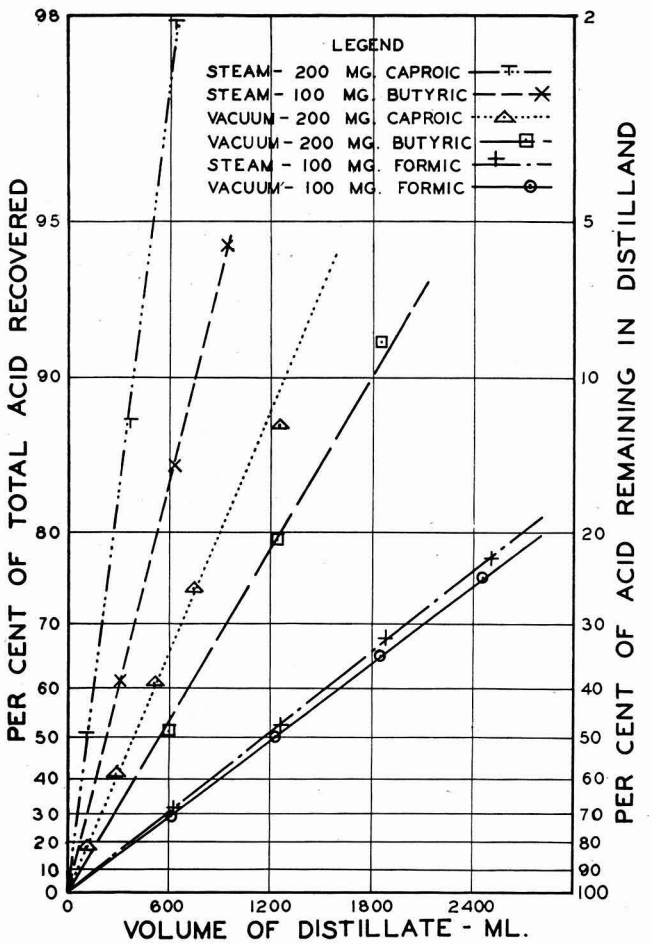

FIG. 1. The rate of vacuum and steam distillation of various acids from aqueous solutions under experimental conditions similar to those used with milk.

The rates of distillation of formic acid with steam and vacuum were about the same, whereas *n*-butyric acid and caproic acid were distilled much more rapidly with steam. Assuming that the rate of distillation of formic acid from the diluted, acidified milk samples was the same as the rate from acidified water, the per cent of the total formic acid in any given volume

of distillate could be determined from the vacuum or steam distillation curve, and thus the amount of formic acid originally present in the sample could be calculated. For example, 600 ml. of distillate (by the vacuum method) would contain 28.7 per cent of the total formic acid in the sample.

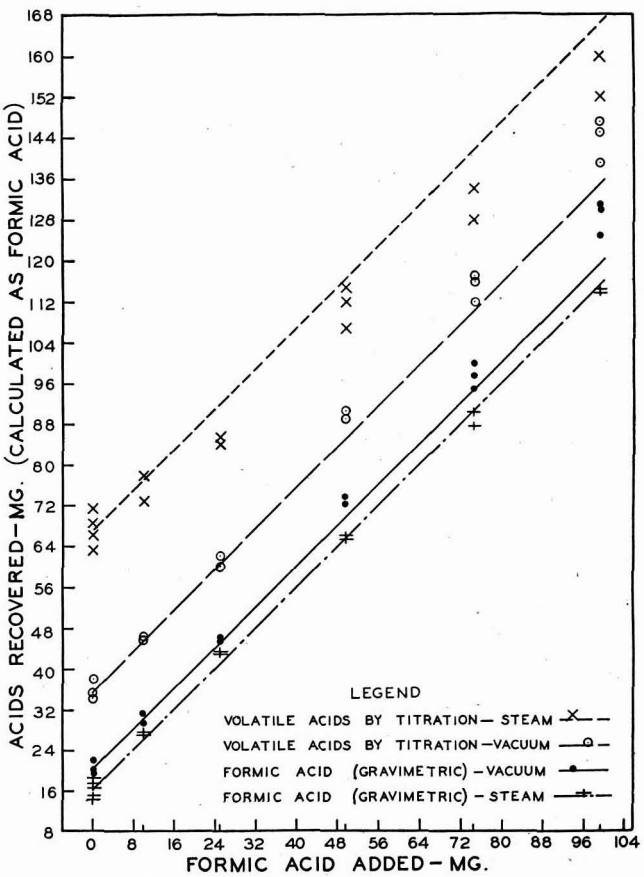

FIG. 2. The recovery of formic acid added to 500-ml. samples of reconstituted sterilized evaporated milk as determined by vacuum and steam distillations.

If the distillate was found to contain 10 mg. of formic acid, the total formic acid in the sample would be 34.8 mg.

In the case of the total volatile acidity determinations, an arbitrary figure was calculated. From the total volatile acidity (as formic acid) in the distillate, the amount in the sample was estimated on the basis of the formic acid distillation curve. This gave values which undoubtedly are high but which permitted a rough comparison of total volatile acidity,

formic acid values, and, by difference, the volatile acids not formic in the distillates.

Recovery of formic acid added to sterilized evaporated milk. For recovery experiments, 48 cans of fresh commercial sterilized evaporated milk were placed in a refrigerator until used. Determinations of volatile acidity and formic acid at intervals during the course of the recovery experiments showed no detectable increase in these constituents up to the time the work was completed.

Amounts of solution containing from 10 to 100 mg. of formic acid were added to diluted evaporated milk samples by running the solution through a capillary into milk which was being agitated with a mechanical stirrer. Approximately 600 ml. of distillate from the 600 ml. of diluted acidified sample was collected by vacuum or steam distillation. Titrations of total volatile acids and gravimetric determinations of formic acid were made on the distillates. Values were corrected to 100 per cent recovery on the basis of the vacuum or steam distillation curve for formic acid.

Figure 2 is a graphic representation of data obtained in determinations of total volatile acid and gravimetric formic acid by the steam and vacuum distillation methods. The four lines were drawn through points obtained by taking the sum of the average acid value obtained on the control samples by each method and the amount of formic acid added. Thus, these lines represent values which *should have been obtained* if the recovery of the added formic acid were 100 per cent in all cases. The points plotted show actual values obtained on individual samples containing from 0 to 100 mg. of added formic acid.

The differences in base values obtained on control samples are clearly shown here. Total volatile acidity as determined by the steam distillations was almost double that determined by the vacuum method. The base value for formic acid determined gravimetrically was higher by 3.9 mg. with the vacuum method than with the steam procedure.

With the vacuum distillation procedure, values for total volatile acidity and formic acid in the control group of samples were quite consistent considering the small quantities present in this milk. The results indicate that the method of calculating the amount of formic acid in the milk from the comparatively small amount recovered in the distillate was at least fairly accurate. The recovery of formic acid calculated on the basis of the titration of the distillate agreed well, in most cases, with the figure calculated on the basis of the gravimetric formic acid determination. Recoveries were slightly high, but generally within the range of accuracy to be expected in work of this kind.

With the steam distillation procedure, recoveries of added formic acid by the gravimetric method were very satisfactory in amounts of 50 mg. or more. With smaller amounts of formic acid the recoveries tended to run high. A

point of particular interest here was the erratic and generally low recovery of formic acid as calculated from the titrations of the steam distillate, with recoveries from 58.7 to 105.7 per cent, the average being 83.8 per cent.

The low recovery of formic acid by titration of the steam distillates apparently was due to the fact that values for volatile acids not formic were lower in distillates from samples to which formic acid had been added, since gravimetric determinations of formic acid in these same distillates showed no loss. The vacuum procedure did not give this difference between titration and gravimetric values. As shown in figure 3, there seemed to be a definite relationship between the amount of formic acid added to the milk

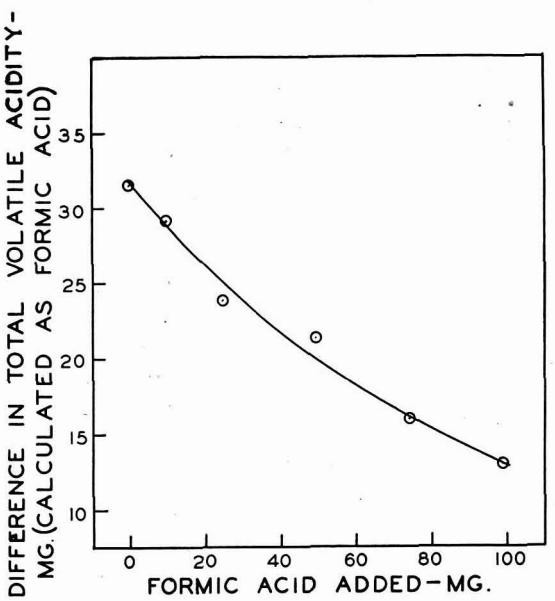

FIG. 3. The effect of amount of added formic acid on the difference between steam and vacuum distillation results for total volatile acidity.

and the *difference* in volatile acidity values between steam and vacuum distilled samples; *i.e.*, as the amount of added formic acid was increased, the difference in volatile acidity between steam and vacuum distilled samples decreased. Consideration of volatile acids not formic may give an explanation for these results.

Volatile acids not formic. Calculation of volatile acids not formic was made on steam and vacuum distilled samples by subtracting the gravimetric formic acid values from the total volatile acidity obtained by titration. In figure 4, volatile acids not formic were plotted against added formic acid. This demonstrated that: (a) Values for volatile acids not formic were much

higher by the steam distillation. (b) The steam distillation showed a definite drop in volatile acids not formic when formic acid was added to the milk. (c) The vacuum distillation values for volatile acids not formic remained fairly constant when the formic acid content of the milk was increased.

Possible explanations of the higher volatile acidity values obtained with steam distillation may be: (a) evolution of carbon dioxide during the steam

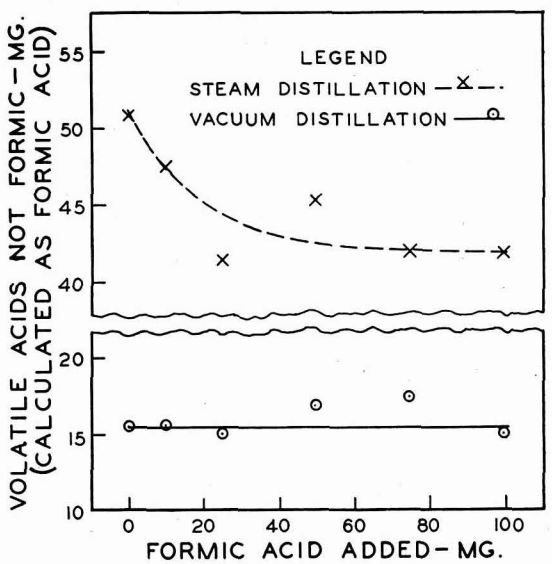

FIG. 4. The relation of amount of added formic acid to the volatile acids not formic as determined by vacuum and steam distillation.

distillation, (b) hydrolysis of glycerides of the lower fatty acids, and (c) more rapid distillation of butyric and higher volatile acids with steam than with vacuum.

The effect of boiling the steam and vacuum distillates to eliminate carbon dioxide is shown in table 1. In these experiments the distillate was titrated with sodium hydroxide under nitrogen as usual. Then standard hydrochloric acid was added in amount equivalent to the sodium hydroxide used in titration. The distillate was heated to boiling as rapidly as possible, boiled for 30 seconds, cooled under protection of a soda-lime tube, and titrated again with sodium hydroxide.

Boiling resulted in considerable loss of acidity in the steam distillate but slight loss of acidity in the vacuum distillate. The amount of formic acid, as determined by the gravimetric procedure, was not decreased appreciably by boiling either steam or vacuum distillate. Negative tests for sulfides on

the steam distillate eliminated the possibility that hydrogen sulfide was causing the high titrations. By placing barium hydroxide solution in the receiving flask during the steam distillation, it was found that carbon dioxide was evolved even after 2 hours of distillation and aspiration with carbon dioxide-free nitrogen. This supports the hypothesis that a part of the difference between volatile acidity values as determined by vacuum and steam distillation was due to dissolved carbon dioxide in the steam distillate. Since a marked browning of the milk occurs during steam distillation, the evolu-

TABLE 1

Effect of boiling evaporated milk distillate on total volatile acidity titration

Distillation procedure	HCOOH added	0.1 *N* NaOH required for approximately 600 ml. of distillate		
		Unboiled	Boiled	Difference
	(*mg.*)	(*ml.*)	(*ml.*)	(*ml.*)
Steam	0	4.23	3.22	1.01
	24.8	5.64	4.22	1.42
	49.6	7.63	6.04	1.59
Vacuum	0.0	2.19	2.18	0.01
	9.9	2.86	2.66	0.20
	49.6	5.57	5.44	0.13
	74.4	7.15	6.91	0.24

tion of carbon dioxide during this treatment would be expected. Tarassuk (10) and Coulter (3) have observed carbon dioxide evolution during browning of milk by heat. These reactions are reported to be accelerated by oxygen (10) and inhibited by reducing agents such as formaldehyde and sodium bisulphite (11).

Even after making correction for the loss of acidity on boiling of the steam distillate, its acidity would be higher by about 34 per cent than that of the vacuum distillate on samples to which no formic acid was added, indicating that other factors contributed to the difference in volatile acidity values obtained by the two methods.

Steam distillation of 5 g. of pure tributyrin homogenized with water and distilled under conditions used on milk was tried and resulted in hydrolysis of 3.5 per cent of the tributyrin in 1.5 hours. Vacuum distillation of tributyrin in water did not hydrolize any of the glyceride. This indicated the possibility of splitting glycerides of lower fatty acids during the steam distillation of milk. However, mixed glycerides such as occur in milk fat probably would be more stable than tributyrin, and so the error due to hydrolysis of glycerides during the steam distillation may or may not be great.

From observations of the distillation curves (Fig. 1) it is evident that the more rapid distillation of butyric and caproic acids with steam could account

for at least part of the difference in volatile acidity as determined by vacuum and steam distillation in these experiments, since total volatile acids in the sample were calculated on the basis of the distillation rate curves of formic acid. However, the amounts of individual acids of higher molecular weight than formic in the distillates were not known, and it is impossible to determine from data obtained just how much this error in calculating total volatile acids contributed to the difference in values obtained by steam and vacuum distillation.

The available data do not show the specific cause for the decrease in volatile acids not formic obtained by steam distillation when formic acid was added to the milk. The limited results obtained by titrations before and after boiling of steam distillates do not indicate that this decrease was due to inhibition of evolution of carbon dioxide by the added formic acid. There seems to be a possibility that formation and/or distillation of part of the volatile acids not formic was inhibited by the presence of formic acid.

SUMMARY

1. A method of determining formic acid and volatile acid values in heated milk by means of vacuum distillation at constant volume is presented. Results of experiments to determine the recovery of added formic acid from sterilized evaporated milk by the steam and vacuum distillation procedures are discussed.

2. The formic acid content of reconstituted evaporated milk averaged about 32 mg./l. by steam distillation and about 40 mg./l. by vacuum distillation.

3. The total volatile acid content of reconstituted evaporated milk, expressed as formic acid, averaged 134 mg./l. by steam distillation and 70 mg./l. by vacuum distillation.

4. The vacuum and steam distillation procedures both gave satisfactory recovery of added formic acid from sterilized evaporated milk by the gravimetric method.

5. There was no evidence of production of formic acid during steam distillation as far as the accuracy of the methods could detect.

6. Titrations of volatile acids on the steam distillates were considerably higher than on the vacuum distillates. The difference could be due to continuous evolution of carbon dioxide from the milk during steam distillation, the more rapid distillation rate of butyric and caproic acids with steam, and/or splitting of glycerides of fatty acids during steam distillation.

7. The addition of formic acid to the milk appeared to reduce the amount of volatile acids not formic obtained by steam distillation.

8. The vacuum distillation showed an advantage over steam distillation where a consideration of the total volatile acids in the distillate was desired.

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CURD TENSION TEST AND CURD NUMBER TEST APPLIED TO MARKET HOMOGENIZED MILK IN PHILADELPHIA— DEFINITION OF A SOFT CURD MILK

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Since the curd number test was described in 1942 (3), this method as well as the curd tension test has been applied regularly in this laboratory to homogenized milks marketed in Philadelphia. The present paper gives a survey of the results and discusses the relationship between curd tension, which deals with the toughness of the curd when milk coagulates, and the curd number, which deals with the size of the curds formed.

The term "soft curd milk" is entirely of American origin and until recently has been practically unknown in other countries. Hill (2) was the first to call attention to the variance in the curd-forming properties of milk, and he designed a special apparatus, manipulated by hand, for testing the toughness of the curd formed under standard conditions. Hill selected a temperature of 95° F. (35° C.) and prescribed a special coagulation solution.

The curd test later was subjected, by a specially appointed committee, to a critical study which resulted in detailed directions for the performance of the test (1). The Hill curd tension meter has been replaced by a mechanically operated apparatus designed by Chambers and now generally used. The curd number test (3) was developed in this laboratory to study closely another aspect of curd formation, namely, the size of the curd. In connection with this study, a baby feeding study was carried out (4).

It generally is agreed that a low curd tension in milk is desirable, especially for infants and people with weakened digestion. A low curd tension is indicative of a soft curd, but even more important is the formation of small curds that will yield a large surface for the action of the digestive juices.

The main objective of this study has been to investigate the relationship between curd tension and the formation of curds as measured by the curd number test, and especially to determine at which curd tension a formation of generally small curds is assured in homogenized milk.

EXPERIMENTAL

A period of one year, June, 1946, to June, 1947, was selected to include all possible seasonal variations. In all, 208 curd number tests, as well as curd tension tests, were performed on market homogenized milks.

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The results of all curd tension values over 10 g. and their corresponding curd numbers are recorded in table 1. Curd tension values below 10 g. frequently were found, indicating extremely soft curd milks. These samples were regarded as without significance for this study, in which the upper

TABLE 1

The relationship of curd tension to curd number

(June, 1946–June, 1947)

No. of samples	Curd tension	Corresponding curd nos.		
		Max.	Min.	Av.
22	10	228	201	214
20	11	229	200	211
18	12	236	200	210
17	13	229	195	210
16	14	231	195	207
23	15	216	195	205
10	16	221	178	202
5	17	214	167	185

limit value for curd tension and the corresponding lower limit value for curd number, characterizing soft curd milks, were sought. Table 1 shows curd tensions from 10 to 17 g. and corresponding curd numbers. Briefly, the curd numbers are arrived at by adding the per centum weight of the curds, divided into three different sizes, large, medium, and small, after having multiplied these figures by one, two, and three, respectively. The presented figures total 131 in number, which means that the rest of the curd tensions, 77 or 37 per cent, were below 10 g. The variance in curd numbers from 10 to 16 g. is not great. None of the figures except one of 178, corresponding to curd tension 16, was below 195. Only five curd tensions of 17 g. were recorded and none over this amount; of these five, the three

TABLE 2

The curd numbers of samples with high curd tensions (17–29)

No. of samples	Curd tension	Corresponding curd nos.		
		Max.	Min.	Av.
8	17	214	135	185
4	20	191	171	178
4	21	180	143	166
3	22	184	164	174
3	28	156	131	139
2	29	171	149	160

relatively low curd numbers, 167, 169 and 175, respectively, indicate the downward trend when the curd tensions increase beyond 16.

From the records taken before 1946, all curd numbers corresponding to a curd tension of 17 g. are recorded in table 2. Of these eight figures, only

two are over 200. The average is the same (185) as for the one-year period tabulated in table 1. Over a period of about 6 years, a few curd tensions of 20 g. and over were encountered. These are tabulated in table 2. Because of their extreme scarcity, they do not have any significance whatsoever in the total picture of curd tensions and curd numbers but are interesting because they show the downward trend in curd numbers with increasing curd tensions. Of special interest are the milks with curd tensions of 20 g., as this is the upper limit value for a milk labeled as "soft curd" according to rules in some states. The average of the four recorded curd tensions of 20 g. is 178, and only one is close to 200. It may seem a little strange that the average curd numbers for curd tensions 22 g. and 29 g. are higher than the average curd numbers for curd tensions 21 g. and 28 g., respectively, but this is only because of the relatively few tests involved. With more tests the higher curd tensions undoubtedly would give corresponding lower average curd numbers. This demonstrates, however, that milks with closely similar curd tensions often vary widely in their curd numbers.

DISCUSSION

In the curd number test study (3) the milk curds were divided into three sizes: large curds, caught by a sieve with 0.5-inch mesh; medium-size curds, caught by a sieve with 0.10-inch mesh; and small curds, caught by a sieve with 0.01-inch mesh.

Breast milk usually has curds only of the small size and accordingly will get the highest curd number rating of 300. In the baby feeding study connected with the curd formation study (4), the great majority of milks fed to the babies had curd numbers of 200 and above (1). This milk was well tolerated, and it was suggested at that time that a milk with curd number 200 and over should be labeled as a soft curd milk.

Hundreds of curd specimens have been studied in an effort to determine what sort of curd combinations represent a curd number of about 200 (195–205). Theoretically it is possible to reach this curd number in many different ways. Even a mix of 50 per cent large curds and 50 per cent small curds with no curds of the middle size would give a curd number of 200. Of course, this combination would not be desirable and such a case never has been encountered. Usually a considerable number of the middle-size curds are present, and for a curd number around 200, the large curds will range from 5 to 15 per cent of the total curd weight. The curd numbers of homogenized milks usually are considerably above 200 and consequently show no large curds at all. Furthermore, it is a matter of experience that the large curds for a curd number of 200 are relatively small or close to the mesh size of 0.5-inch in diameter.

Since milk with a curd number of 200 and above, corresponding to a curd tension of 15 g. or less, is well tolerated by infants in general (4),

and since milks with curd tensions above 15 g. contain an increasing number of specimens with curd numbers below 200 as the curd tension increases, it seems reasonable to label milks with curd tensions of 15 g. or below as "soft curd" milks, meaning both "soft" and "small curd" milks.

SUMMARY

The curd tensions and corresponding curd numbers (curd sizes) of market homogenized milk in Philadelphia have been recorded over the period of one year. On the basis of this material, combined with experiences from baby feeding studies and more than 5 years of constant testing of curd tensions and curd numbers, it is suggested that a "soft curd" milk be defined as a milk with a curd tension of 15 g. or below. Since this corresponds to a curd number of 200 or above, it indicates a milk with both soft and small curds.

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VARIATIONS IN YIELD OF MILK UNDER THE PENKEEPING SYSTEM IN BRAZIL

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The program for dairy cattle improvement in the state of Minas Gerais in Brazil includes investigating the effects of the special conditions existing under the penkeeping system (*sistema de retiros*) of dairy cattle management. This system is widely used in the *Zona da Mata* (originally a forested region) in the southeastern part of Minas Gerais. The penkeeping system and some of the problems encountered already have been described by Rhoad (5) and by Carneiro (2). Some of the findings from these studies appear to be of general interest.

In the penkeeping system the cattle are kept on pasture the year around. They are divided into *retiros* or pens of 20 to 40 head each. The cows are with their calves in the pasture during the day but are penned up in the evening and remain separated from the calves until they are milked in the morning. As a rule the only feed they get is pasture, but in recent years some use has been made of chopped sugar cane, grass silage, and even cottonseed meal and wheat bran during the dry season. The climate is hot and the annual rainfall is high, with two definite seasons, a rainy one from October to March and a dry season from April to September. The most important among the pests and diseases include ticks, "*berne*" (*Dermatobia hominis*), flies, worms, foot-and-mouth disease, anthrax, blackleg, pneumonia, and tick fever.

The principal objectives of the present study were to determine: (a) How much the average milk production changed from one year to another and the extent to which these year-to-year changes were part of a general time trend or were only irregular variations. (b) How the milk production varied at different times of the year. (c) The shape of the lactation curve with advancing lactation. The findings concerning the sex ratio and preliminary observations on heritability also are reported.

EXPERIMENTAL PROCEDURE

The records came from "Niagara" farm near Leopoldina, Brazil. This is a private farm which kept grade Simmenthaler cattle under management

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practices thought to be typical of the penkeeping system in that region. The records were for lactations begun in the years 1930 to 1937. The number of cows in milk ranged from 233 to 318. Milk yields were measured on the first and the sixteenth of each month. All the data on yield are in liters. Under the penkeeping system either the death of the calf or sickness of the cow affects production sharply. Lactations were considered abnormal and were omitted from this analysis if the cow was seriously sick, as from foot-and-mouth disease, or if the calf died or the cow was sold early in the lactation. Of the 2,177 lactations recorded, only 1,318 (slightly over 60 per cent) were considered normal. Table 1 shows for each year the number of lactations and the means and standard deviations for length of lactation and for milk yield in the normal lactations. The ratio of normal to abnormal lactations fluctuated widely from year to year, as might be expected from the fact that outbreaks of foot-and-mouth or other disease often would cause a heavy loss in some *retiros* or in some years but not in others.

TABLE 1

Normal, abnormal and total lactations by years

Year	No. of lactations			Milk yield (l.)		Lactation period (days)	
	Normal	Abnormal	Total	Mean	σ	Mean	σ
1930	194	70	264	1,105	386	289	66
1931	97	136	233	1,144	402	316	82
1932	161	81	242	1,282	344	313	67
1933	75	195	270	1,129	348	287	72
1934	196	56	252	1,207	365	305	64
1935	213	70	283	1,261	413	301	65
1936	187	128	315	1,226	407	285	63
1937	195	123	318	1,242	413	304	61
Summary	1,318	859	2,177	1,209 ±11	393	299 ±2	67

RESULTS

Year-to-year differences in yield and in length of lactation period. Table 1 shows how the means varied from one year to the next. Table 2 shows the analysis of variance between and within years. Since the effect of year on length of lactation only bordered on statistical significance and was slight in any case, its analysis was carried no further.

The mean yield differed from year to year with unmistakable statistical significance. The analysis to test whether those year-to-year differences were wholly irregular or whether a part of them could be attributed to a straight-line trend also is shown in table 2. The trend is an average increase of 16.7 l. per year, ($Y = 1147.4 + 16.7X$) but the yearly means changed too irregularly for statistical significance to be assured. Other

things besides the steady trend (if that actually is real) obviously have much to do with causing the mean to be high in some years and low in others. A rough computation of the variance components indicates that about 40 per cent of the variance caused by year-to-year changes in the mean can be at-

TABLE 2

Variation in milk yield between and within years

Source of variation	*d/f*	Milk yield		Length of lactation	
		Mean square	*F*	Mean square	*F*
Total	1,317	154,284	.....	4,423	.....
Regression	1	1,924,583	4.16	11,099	2.53*
Yearly means from the regression	6	462,486	3.05**		
Between cows within years	1,310	151,521	.....	4,388	.....

* = Significant.
** = Highly significant.

tributed to the straight-line trend. The other 60 per cent of the year-to-year variance comes from causes which had irregular incidence from one year to the next. However, the year-to-year variations were not a large part of the total causes of individual variation, since the variance compoment for year-to-year differences, including the trend, is only about 2 per cent of the variance between records made within the same year. The individual variation found between records made within the same year (necessarily by different cows) is so large that even an indicated increase of nearly 1.4 per cent per year is by comparison a small source of variation. This small increase, however, eventually would mean much to the dairy industry if it is real and if it continues for many years.

Season of year. Only a portion of the data was used for measuring how yield varied with the season of the year, 50 of the normal lactations being

TABLE 3

Variance of daily milk yields between and within months of the year

Source of variation	*d/f*	Mean square	*F*
Total	3,876	2.722	.....
Between months	11	29.236	11.05**
Within months	3,865	2.646	.....

** = Highly significant.

selected from each of the 8 years. The selections were random except that some effort was made to get the calving dates equally distributed among the 12 months, so that stage of lactation would not be confounded with season of year. This was not wholly achieved. The 400 records included slightly more than a fair share which began from March to May and too few which

began in December and January. The 400 lactations provided 3,877 daily milk yields, using only the yields measured on the sixteenth of each month. Table 3 shows the analysis of variance between and within months.

The effect of month is unmistakably significant statistically but is not large enough to be of much practical importance, since the mean square is reduced only about 2.8 per cent by "holding month constant". The present results agree fairly well with those of Rhoad (5), as shown in table 4. The

TABLE 4

Mean daily milk yield by months

Month	Present study		Rhoad's study	
	Mean	Deviation of monthly mean from annual mean	Mean	Deviation of monthly mean from annual mean
	(*l.*)	(%)	(*l.*)	(%)
Jan.	4.31	+ 6.2	4.42	+10.0
Feb.	4.41	+ 8.6	4.57	+11.2
March	4.40	+ 8.4	4.42	+ 9.9
April	4.33	+ 6.6	4.23	+ 5.2
May	4.24	+ 4.4	3.84	- 4.5
June	3.96	- 2.5	3.63	- 9.7
July	3.77	- 7.1	3.62	-10.0
Aug.	3.60	-11.3	3.38	-15.9
Sept.	3.60	-11.3	3.62	- 9.9
Oct.	3.89	- 4.2	3.95	- 1.7
Nov.	4.14	+ 2.0	4.21	+ 4.7
Dec.	4.24	+ 4.4	4.42	+ 9.9
General mean	4.06	.....	4.02	.....

effect of month is a bit more extreme in Rhoad's data, but the season of year when the yields are below average (after the dry season is well begun) is almost the same. Likewise, the maximum in both sets of data occurs from the middle to near the end of the rainy season. As one evidence that Rhoad's data show more extreme seasonal variations than the present data, the rate of decline from the highest month to the lowest by Brody's (1) formula, $k = \frac{1n\ Y_2 - 1n\ Y_1}{t_2 - t_1}$, yields values of 0.050 and 0.034 per months for Rhoad's data and for the present data, respectively. The difference can be attributed plausibly to the fact that the cows studied by Rhoad received no supplementary feed, while those used in the present study had some grass silage and some chopped sugar cane during the winter (dry) season. Also, it is possible that the few cases of twice-a-day milking in the present data were more frequent in the dry months, although that is not known for certain.

It seems worth emphasizing that the dry season in the tropics and subtropics appears to affect both milk production and growth, primarily through

its effect on the feed supply. This observation checks both with the present study and Rhoad's study and also with the results reported by Schutte (6) on the growth of beef cattle in South Africa. Schutte points out that rainfall rather than *season per se* causes the seasonal deviations, since the maximum growth of feed occurs approximately 3 months after the time of greatest precipitation.

Shape of the lactation curve. It is well known that under conditions of dairy management usual in the temperate zone, the lactation curve rises at the beginning of the lactation, reaching a maximum around 30 to 50 days after parturition, and then declines to the end of the lactation period. Whether this relation is the same under the penkeeping system was investigated by sorting the daily yields according to their order in the lactation. Yields measured in the first 14 days after parturition were called "first measurements", those from the 15th to the 29th day were called "second measurements", those from the 30th to the 44th day were "third measurements", and so on. This method of sorting placed all records with the same order of measurement in nearly the same segment of the lactation curve. Necessities of management, such as changing a cow from one *retiro* to another and accidents, of course resulted in failure to obtain some figures for

TABLE 5

Mean daily milk yields, in liters, at 15-day intervals from calving to the 30th measurement (450 days)

Order of measurement	No. of lactations	Mean yield	Order of measurement	No. of lactations	Mean yield	Order of measurement	No. of lactations	Mean yield
		(*l.*)			(*l.*)			(*l.*)
1	523	4.35	11	1316	4.18	21	579	3.01
2	1113	4.76	12	1313	4.12	22	482	2.95
3	1286	5.00	13	1308	4.04	23	379	2.85
4	1309	4.98	14	1290	3.94	24	288	2.75
5	1314	4.85	15	1264	3.85	25	288	2.75
6	1314	4.64	16	1201	3.67	26	174	2.63
7	1314	4.58	17	1125	3.51	27	136	2.65
8	1315	4.44	18	996	3.35	28	102	2.59
9	1315	4.37	19	836	3.24	29	75	2.58
10	1315	4.32	20	700	3.12	30	59	2.55

daily yields, especially those for yields at the first measurement date after parturition. The average number of days from calving to the first yield recorded was 18.6 ± 0.3. Many of the cows began to go dry about the time of the 16th measurement (*i.e.*, about 240 days), but a few continued through the 30th measurement. These averages are shown in table 5 and in figure 1.

Table 6 shows an analysis of variance within and between order of measurements. The effect of stage of lactation is statistically significant beyond all doubt and is large enough to be economically important, as somewhat more than 15 per cent of the variance between individual daily yields disappears when stage of lactation is held constant. The correlation be-

TABLE 6

Analysis of variance of daily milk yield between and within stages of lactation

Source of variation	*d/f*	Mean square	*F*
Total	25,968	2.74	.....
Between orders of measurement	29	38.21	16.5**
Within orders of measurement	25,939	2.32	.....

** = Highly significant.

tween yield and order of measurement was –0.198. That this value was no larger numerically when the reduction in variance was over 15 per cent, of itself shows that the relation was not entirely linear. The straight regression lines shown in figure 1 were fitted separately. The rising one was fitted to the first three measurements and the declining one to the third to 30th measurements. The slope of the rising line is an average increase of 0.314 l. per 15-day interval, while the slope of the declining one is an average decrease of 0.107 l. per 15-day interval. Admittedly the sharp break in the curve at the third measurement is an artifact, resulting from the arbitrary division of the data at this point. The true curve probably sweeps

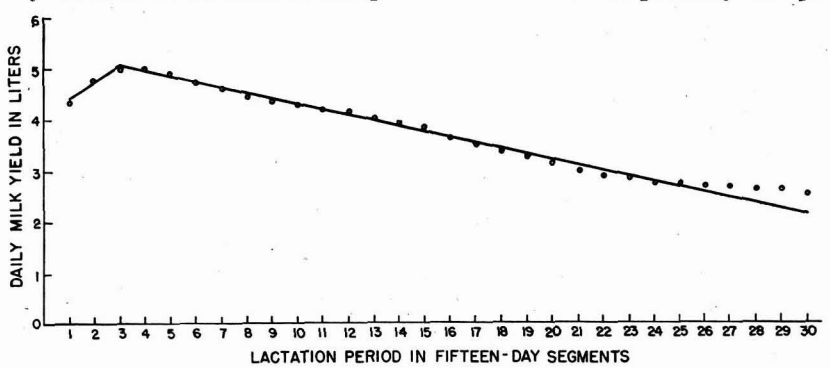

FIG. 1. Yields in successive stages of the lactation period.

smoothly with decreasing slope up toward a maximum and then slowly turns down again. However, as the choice of type of curve had to be arbitrary, further refinements to fit a single curve to the whole set of data did not seem worth while.

A straight line fits most of the declining part of the curve well until near the very end. There the numbers are few and it seems likely that the apparent lessening of the slope may be the result of selection, whereby those

which went dry and dropped out at each interval would mostly have been those which were producing the least at the preceding measurement. The rate of decline in the declining segment amounts to only 2.3 per cent each 15 days at the beginning of that portion, but is as much as 4.1 per cent of the current production by the time the lactation is about 12 months along. If the rate of decline from measurements 3–5 to measurements 24–26 is computed according to Brody's (1) formula (which, however, would make the regression a bit curvilinear), the decline is 2.86 per cent for each 15 days or about 5.7 per cent per month.

These rates of decline are not very different from those reported for dairy data from the type of management usual in temperate regions, although the means are much lower. Thus Brody (1) reports declines per month of 5.3, 5.5, 5.6, and 5.7 per cent, respectively, for groups of Holstein, farrow Guernsey, Jersey and Guernsey cows. It is somewhat surprising that the rates of decline should be so nearly the same in these data from a breed which is more nearly dual purpose, with cows milked only once a day, fed little but pasture, some of which was not very good, and suckled by their calves during the day. Possibly the management holds the production so much below the cow's inherent ability that this level of production remains more stable than it would under better management. However, this is only a tentative suggestion needing more investigation. Perhaps Brody's estimate that scrub cows decline almost 17 per cent per month needs testing on a wider variety of data. The progressive elimination of those which had been producing the least in each preceding month could explain the apparent slowness of the decline here after about the 15th measurement, but it could not explain the slowness of the earlier decline. There is no indication that such elimination is a noteworthy factor until about the 26th measurement.

TABLE 7

Sex ratio among the calves

Year	Males	Females	Total
1930	149	116	265
1931	108	124	232
1932	130	113	243
1933	135	124	259
1934	129	106	235
1935	154	138	292
1936	173	154	327
1937	164	146	310
Total	1,142	1,021	2,163

Sex ratio. Although not a primary object of this study, the sex distribution by years was tabulated and is shown in table 7. Like most other reports on the sex ratio in cattle, this study shows a slight but statistically significant excess of males. The males comprised 52.8 per cent of the calves.

This compares with 51.8 reported by Crew (3), or the 50.5 by Gowen and Pearl, 49.4 by Roberts, 51.5 by Johansson, 52.2 by Ward, and 49.9 by Engeler, as quoted by Lush (4). The males were in excess every year except 1931 and in that year the difference was small. The statistical test for homogeneity from year to year yields a chi-square value of 5.42, which actually is a bit less than expected for seven degrees of freedom. Therefore, the conclusion is reached that the males were genuinely in excess of the females at Leopoldina, for reasons not known to the authors. This is in agreement with most other studies of the sex ratio in cattle. Whatever factor made the sex ratio depart from exact equality seems to have prevailed over all the years.

Heritability. Only a preliminary study of the heritability of individual differences in milk production has yet been made. The still unverified estimates are in the neighborhood of 0.5, which seems rather high as compared with most other studies. However, the herd contained cows of several different kinds of breeding. Some kinds contained distinctly higher percentages of dairy blood than others. This genetic heterogeneity would tend to make the heritability of differences within such a population higher than within a group which were all purebreds or high grades of the same breed. Also, the peculiarities of the penkeeping management, such as whether a cow would let down her milk freely to the hand milker in the morning when accustomed to being milked by the calf during the day, might make a noticeable difference. It is conceivable that the differences in behavior between the cows in this respect could be large and strongly hereditary. Speculation on this point seems unjustified until the existing evidence can be verified and examined from every point of view. The preliminary examination indicates a rather high level of heritability of individual differences in milk production under the penkeeping system.

SUMMARY

Records from a large farm in the *Zona da Mata* in Brazil were studied to learn about conditions which affect milk production under the penkeeping system.

Production varied significantly from year to year. Part of this is ascribed to an upward trend with time, but the statistical significance of that trend is not wholly assured. Some of the yearly means deviated rather widely from that trend.

Season of year had significant but rather small effects on the daily yield. The higher yields were toward the middle and end of the rainy season, while the lower ones were late in the dry season.

Production reached a maximum some time around 40 to 50 days after calving. Thereafter it declined in almost a straight line.

The sex ratio showed a slight but statistically significant excess of males. The year-to-year deviations of the sex ratio from the general mean were not statistically significant.

Heritability of individual differences in milk yield under these conditions seems moderately high.

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ABSTRACTS OF LITERATURE

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CONTENTS

Bacteriology
Breeding
Butter
Cheese
Chemistry
Concentrated and dry milk; by-products
Diseases
Feeds and feeding
Food value of dairy products
Herd management
Ice cream
Milk
Miscellaneous
Physiology

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ABSTRACTS OF LITERATURE

BOOK REVIEW

66. Food regulation and compliance. Vol. II. A. D. HERRICK. 655 pp. $10.00. Revere Publishing Co., New York 4, N. Y. 1947.

This is the second volume of an interpretation of the Federal Food, Drug, and Cosmetic Act as it applies to food. Special attention is given to the adulteration of foods, including that occurring during processing, packaging and shipping. Considerable space is given to problems of administration of the Act and to a description of the powers of those concerned with its enforcement. Activities connected with the control of importation and exportation of foods are discussed, as are methods of inspection of premises and sampling of products. The book describes the regulation of foods under the Act. It is quite general; yet the many examples given illustrate interpretations of specific conditions.

There is no section devoted, as such, to dairy products. They are mentioned incidentally with other types of foods. Its value to persons interested mainly in dairy products lies in the information given concerning the interpretation of the law and in the description of the methods of enforcement.

The chapter headings illustrate the subject matter discussed. They are as follows: Adulteration in Food Products, Harmful Substances in Foods, Contaminated Foods, Insanitary Premises and Processing, Deleterious Containers, Economic Adulteration, Adulteration in Confectionery, Administrative Regulations, Imports and Exports, Emergency Permit Control, Coal-tar Colors, Inspections and Sampling, Enforcement Means and Methods, Offenses and Violations, Criminal Prosecution, Seizure Proceedings, Injunctive Proceedings. There is an appendix entitled "Federal Food, Drug, and Cosmetic Act and General Regulations for Its Enforcement" in which the drug and cosmetic sections and general regulations are omitted. M.P.B.

BACTERIOLOGY

67. The effect of variations in technique on the plate count of milk powders. A. H. WHITE, Div. Bacteriology and Dairy Research, Dept. of Agr., Ottawa, Canada. Sci. Agr., *27*, 9: 405–413. Sept., 1947.

A study on the influence of type of diluent, temperature of diluent and temperature of incubation in the bacteriological analysis of milk powder by the plate method is reported. Spray process whole milk powders and spray and roller skim milk powders were analyzed. The use of 0.1 N

lithium hydroxide as a diluent greatly reduced plate counts, probably due to the high alkalinity or pH of the solution. Even when diluted 1:100, the pH values of reconstituted milks averaged 9.65. Reconstituting the milk with the diluent at 50° C. resulted in increased plate counts as compared to using a diluent at room temperature. An incubation temperature of 32° C. as compared to 37° C. had little effect on the counts. However, the lower temperature is recommended if available. O.R.I.

68. Sur une méthode simple d'isolement et d'étude des ferments de l'arome des beurres. (On a simple method for isolation and study of aroma-producing ferments of butter.) JEAN KEILLING AND A. CAMUS. Lait, *27*, 265–266: 235–237. May–June, 1947.

Based on the premise that aroma-producing organisms develop more satisfactorily in a medium of diluted buttermilk, a method has been devised for the isolation and examination of organisms of this type. One milliliter of serum from butter to be tested is transferred to 1% sterile glucose solution at 20° C. After being shaken at intervals for 2 hr., 1-ml. transfers are made to sterile milk diluted 50, 75, 90, 95 and 98% with sterile water. These tubes are maintained at 18° C. for 24 hr. The contents of each tube then are examined microscopically and diacetyl content determined. Cultures showing desirable properties on these tests then are purified by serial dilution and propagation on solid media. O.R.I.

69. Method of carrying out fermentation processes for production of riboflavin. H. L. POLLARD, N. E. RODGERS, AND R. E. MEADE. (Assigned to Western Condensing Co.) U. S. Patent 2,433,063, Dec. 23, 1947 (4 claims). Official Gaz. U. S. Pat. Office, *605*, 4: 622. 1947.

The synthesis of riboflavin by the fermentation of sterilized whey or skim milk by *Clostridium acetobutylicum* is improved by having the iron content in excess of 0.1 and 0.21 p.p.m. and the pH maintained in a definite range depending on the quantity of iron. R.W.

70. Method of preparing riboflavin from whey and skimmilk. N. E. RODGERS, H. L. POLLARD, AND R. E. MEADE. (Assigned to Western Condensing Co.) U. S. Patent 2,433,064, Dec. 23, 1947 (4 claims). Official Gaz. U. S. Pat. Office, *605*, 4: 623. 1947.

Essentially the same as U. S. Patent 2,433,063 (see preceding abstract) execept that the pH of the medium is adjusted to 5.8 to 6.5 with lactic acid prior to sterilization. R.W.

71. Method of preparing riboflavin from lacteal material. R. E. MEADE, N. E. RODGERS, AND H. L. POLLARD. (Assigned to Western Condensing Co.) U. S. Patent 2,433,232, Dec. 23, 1947 (6 claims). Official Gaz. U. S. Pat. Office, *605,* 4: 667. 1947.

The production of riboflavin from whey or skim milk by *Clostridium acetobutylicum* is increased by incorporating xylose in the medium.

R.W.

BREEDING

72. The causes and diagnosis of infertility in bulls. G. R. MOORE. J. Am. Vet. Med. Assoc., *112,* 850: 25–29. Jan., 1948.

The causes of sterility in the bull may fall logically into 3 groups: (a) those caused by inflammatory processes of the testes and of the tubular genitalia, (b) testicular hypoplasia and degeneration due to hormone deficiencies and other causes, and (c) functional disturbances due to systemic ill health, senility, malnutrition, obesity and lack of exercise. Certain precautions in management and breeding may greatly improve the fertility of sires. Selecting for reproductive efficiency and good fertility is extremely important in any breeding program. It also is a good management policy to provide the young sire with adequate green feeds, protein supplements, minerals, and an opportunity for an abundance of exercise for best breeding efficiency.

T.M.L.

73. Cost of getting cow with calf. W. F. SCHAEFER. Guernsey Breeders J., *73,* 1: 11–13. Jan. 1, 1948.

The cost of keeping bulls at the Nepa Artificial Breeding Cooperative, Tunkhannock, Pa., averaged $614 in 1946. This amount included: Lease fee and depreciation of bulls owned (depreciation 50% per year) $222, feed $175, labor $150, housing $37, bedding $12, trucking $11, veterinary $7. During the year, 23,141 cows were bred at a cost of $3.95 per cow offered for service. An average of 1.53 inseminations was required per cow.

A.R.P.

BUTTER

74. A fluorescence method for assessing the keeping quality of butter. G. A. GRANT AND W. HAROLD WHITE, Natl. Research Laboratories, Ottawa, Canada. Can. J. Research, F, *24:* 461–466. Nov., 1946.

A method was developed for determining the fluorescence of the diluted sera of butter samples. Fluorescence values were found to be related to flavor scores of salted butters which had been stored at high temperatures. The recommended procedure was as follows: The serum was separated by placing 125 g. of butter in centrifuge bottles and heating in a boiling water bath, centrifuging at 1700 r.p.m. and siphoning off the fat. Two ml. of the

serum was diluted to 50 ml. with 10% sodium acetate, the pH adjusted to 5–6, and the fluorescence values determined immediately in a Coleman photofluorometer using a filter that transmitted light in the region of 365 mμ. This procedure gave fluorescence values that were correlated with flavor scores ($r = -0.84$) on salted butters stored at 32.2° C. (90° F.) and sampled at intervals during 32 days. O.R.I.

75. Contribution a la connaissance du beurre de brebis (beurre de cashcaval) prepare en Roumanie. (Contribution to the knowledge of sheeps' butter (cashcaval butter) prepared in Roumania.) C. STOIAN. Lait, *27*, 267 : 342–352. July–Aug., 1947.

In the making of cashcaval cheese from sheeps' milk, the curds are heated by hot water and high losses of fat occur. This may be salvaged either by gravity or centrifugal separation. Butter oil prepared from this fat is marketed in southeastern Roumania. Eight commercial samples were analyzed for such physical and chemical constants as melting and solidification point, index of refraction, specific gravity, saponification, Reichert-Meissl, Polenske and other values. Widely varying values were obtained in melting and solidification points, but in other respects fairly uniform values were found. The average R-M value was 29.88 and the average P value 4.53. O.R.I.

CHEESE

76. Factors influencing the quality of cheese. H. L. WILSON. Can. Dairy Ice Cream J., *26*, 11 : 45. Nov., 1947.

Sanitation is the most important factor confronting the cheese industry. The operator of a clean, sanitary plant should not accept milk of inferior quality. All bacteria foreign to cheesemaking should be eliminated. The control and proper rate of acid development are important in the making of a good uniform quality of cheese. The time element also is very important; 2.25 hr. should elapse from setting to drawing the whey, and at least 2.25 hr. from time of drawing whey to milling. To make a cheese that is uniform in quality as well as type, a uniform method and time schedule must be used, varying only those steps that are necessary because of bacterial action. H.P.

77. Rheological experiments carried out on Gruyere. G. MOCQUOT, G. W. S. BLAIR, AND M. BARON. Natl. Inst. for Research in Dairying, Shinfield, England. Dairy Inds., *12*, 10: 966–976. Oct., 1947.

The measurement of superficial density used for Cheddar cheese manufacture in England has been applied to the production of Gruyere type cheese made in French Jura. The method (described in a previous publication in 1940), which measures the superficial density of the curd, was found

to be very valuable to cheesemakers, particularly when they are confronted with the processing of abnormal milks (mastitis, high acid, etc.).

Measurements for plasticity and elasticity by means of a ball compressor during curing constitute a valuable tool in predicting the future quality of cheese. With this information the cheesemaker can then correct or prevent certain defects from developing by such procedures as accelerating or retarding ripening. D.V.J.

78. Apparatus for use in the centrifugal separation of serum from cheese constituents. G. J. STREZYNSKI. (Assigned to De Laval Separator Co.). U. S. Patent 2,432,829, Dec. 16, 1947 (13 claims). Official Gaz. U. S. Pat. Office, *605*, 3 : 507. 1947.

A centrifuge has been developed which continuously removes whey from a cultured milk-cream mixture to form cream cheese. The mixture passes through a revolving bowl which is provided with 2 outlets, one for the lower density constituent whey and the other for the concentrated curd and fat. The movement of the latter is facilitated by a scaper or conveyor and by maintaining the incoming temperature of about 160° F. through suitable insulation of the equipment. The mechanism is so designed that the curd and fat mixture is not aerated as it continuously leaves the bowl and moves through the supplementary devices. Measured amounts of such desirable additives as gum, salt and flavoring ingredients may be continuously injected into and intimately mixed with the cream cheese as it is discharged from the machine. R.W.

CHEMISTRY

79. Différenciation de la caséine et de la lactalbumin e par un processus microbien. (Differentiation of casein and lactalbumin by a microbial process.) JEAN KEILLING AND A. BARRET. Lait, *27*, 267 : 337–342. July–Aug., 1947.

In the course of studying dairy fermentations, a mycoderm was isolated which possessed the ability to digest casein to amino acids. No amino nitrogen, as determined by the Sorensen method, was produced in media in which albumin was the source of nitrogen. The organism on solid media produced small round colonies with irregular contours. The cells were elongated, 3–5 μ in diameter and 5–6 μ in length. They reproduced by budding. When cultured in milk, a maximum yield of amino nitrogen was obtained in 16 days at 30° C. The total lactose of milk was not greatly reduced after 16 days. It is suggested that this organism will be of value in laboratory determinations and in the ripening of soft cheese. O.R.I.

80. Analyse des crèmes. (Analysis of creams.) R. MOREAU. Lait, *27*, 265–266 : 257–258. May–June, 1947.

A modification of the Koehler-Bacot method is proposed whereby the

sulfuric acid and water would not be added separately to the butyrometer but would be mixed in the proportion of 5 ml. of water to 10 ml. acid prior to being added. After adding amyl alcohol, the tubes are placed in a water bath at 85° C. to facilitate digestion. The fat columns are measured at 65° C. O.R.I.

DISEASES

81. Mastitis. R. F. WAECHTER. Can. Dairy Ice Cream J., *26,* 11: 90. Nov., 1947.

Chronic mastitis, the type most frequently found, is defined as a progressive inflammation of the udder or mammary gland. From this infection, the milk secreting tissues in the gland gradually are destroyed. Mastitis can be detected by the strip cup, manipulation of the udder, or by bacteriological tests. Methods of control require hygienic stable and milking conditions. Newer methods of treatment include the use of the newer sulfa drugs and penicillin. The use of mastitis mixed bacterins in the treatment and prevention of mastitis is recommended. The advice of a veterinarian should be obtained when the disease is observed. H.P.

82. Streptomycin in the treatment of calf pneumonia. R. F. VIGUE. J. Am. Vet. Med. Assoc., *111,* 848: 389–390. Nov., 1947.

In 7 cases of calf pneumonia, 3 of which were complicated with diarrhea, all terminated favorably after streptomycin was used in addition to blood transfusion and oral sulfadiazine therapy. T.M.L.

83. Treatment of pneumonia in cattle. S. J. ROBERTS AND G. K. KIESEL. J. Am. Vet. Med. Assoc., *112,* 850: 34–39. Jan., 1948.

Treatment with sulfamerazine, sulfamethazine and penicillin resulted in the recovery of 94.6% of 129 cases of the pneumonia form of hemorrhagic septicemia in older cattle; 93 calves treated in the same fashion gave 81.7% recovery. Although no animals were kept untreated for checks, evidence indicates that treatment with the newer pyrimidines has been somewhat effective in reducing losses of cattle from pneumonia. When sulfamerazine and sulfamethazine were used in the recommended dosages of 0.5 to 0.75 gr. per lb. of body weight daily, no toxic reactions were observed. T.M.L.

84. A further report on staphylococcic abortion in a dairy herd. W. D. POUNDEN, L. C. FERGUSON, C. E. KNOOP, AND W. E. KRAUSS. J. Am. Vet. Med. Assoc., *111,* 848: 376–378. Nov., 1947.

In a herd of 50 cows bred artificially to 7 different bulls, 6 out of 15 cows bred to one particular sire aborted. The time of abortion varied from 137 to 242 days. All animals that aborted were inseminated anterior to the cervix. (This procedure was used as a precaution against further in-

fection.) An organism resembling *Staphylococcus albus* was recovered from the necrosed cotyledons or pus in 4 instances. In 2 cases the organism was found in the aborted calves. Organisms of apparently similar characteristics were recovered from semen samples from the bull in question. All cows bred were negative to tests for brucellosis and trichomoniasis.

T.M.L.

ICE CREAM

85. Overrun control in ice cream. P. H. TRACY, Dept. of Dairy Husb., Univ. of Ill. Ice Cream Field, *50,* 4: 88, 89. Oct., 1947.

The importance of overrun control is stressed and data given to show the relation of overrun to ice cream ingredient cost. However, ingredient costs are not the only ones affected by producing ice cream with lower overrun. The author states: "The aim of the industry at the present time is an ice cream with an overrun of about 60 percent." Dipped ice cream should have slightly more than 50% overrun; fewer problems result in producing packaged ice cream at an overrun of 60–65% than at 50%. Dipping materially changes the texture of ice cream. Low overrun (40–60%), machine filled packages have a better texture than hand dipped packages with the same overrun. The author suggests that ice cream be frozen to the usual 100% overrun and, after partially freezing, part of the air be pressed out so as to obtain the desired overrun. The economics of the problem requires that the industry ascertain the optimum overrun consistent with quality and the willingness or ability of the consumer to pay.

W.C.C.

86. The shrinkage problem. C. D. DAHLE AND J. A. MEISER, JR., Dept. of Dairy Husb., Pennsylvania State College. Ice Cream Rev., *31,* 5: 64, 67. Dec., 1947.

In order to obtain information as to the prevalence of shrinkage in ice cream and to learn of methods used by the industry to combat it, a questionnaire was submitted to members of the I.A.I.C.M. The answers indicated that more shrinkage occurred in plants using sweetened condensed milk than when other forms of concentrated milks were used. The elimination of wheat sirups from the mix eliminated shrinkage in 11 out of 18 plants using this product. Eliminating or reducing the amount of other sirups also eliminated a considerable amount of shrinkage. Lowering hardening room temperatures from +5 or −10° F. to −15 or −20° F. was effective in reducing shrinkage in several cases. Freezing ice cream to a lower temperature at the freezer and slowing down the continuous freezer were found helpful in controlling shrinkage. Some plants reported they stopped shrinkage by changing stabilizers, and 3 plants stopped their trouble by eliminating the use of emulsifiers. There is no single remedy for the shrinkage problem.

From results of research work, as well as from information obtained from the questionnaire, it would appear that the use of sweetened condensed milk, the use of certain sirups in the mix, the presence of free fatty acids, the use of emulsifying agents, improper surface of paper containers, improper temperatures in the hardening room and cabinets, and season of year may contribute to shrinkage. W.J.C.

87. Vanilla, the edible orchid. N. C. LARSEN, Polak & Schwarz, Inv., Ice Cream Trade J., *43,* 8: 72, 73, 85–88. Aug., 1947.

This article deals with the early history relating to the discovery of the vanilla bean, definitions of the various types of beans, how they are propagated, cured and packaged, quantity consumed, composition and uses. W.H.M.

88. Defrosting. S. RUPPRIGHT. Ice Cream Trade J., *43,* 8: 78, 98. Aug., 1947.

Defrosting of refrigeration coils may be accomplished with outside air or with hot gas from the high side of the refrigeration system or brine in a brine system through valved connections. Another method is by use of heat of dissolution liberated by thinning a brine with the substance of the frost. Electrical resistance heat may be used when the resistance wire is thermally united with the coil. Water also is used as a carrier of heat for defrosting evaporator coils. Water defrosting may result in freeze-ups unless done quickly with special equipment. The washing effect of water is desirable and aids in removal of odors from the coils. W.H.M.

89. Improving packages. J. H. ERB, The Borden Co. Ice Cream Trade J., *43,* 10: 104, 144, 145. Oct., 1947.

The most common faults of much packaged ice cream are high overrun, weak body, course texture, fluffy body and poor flavor. Packaged ice cream should have a fine flavor, smooth texture and firm body. A total solids content of 38.5 to 40% is desirable. The use of corn sirup to gain in non-sweet solids and of high grade egg yolk to produce small air cells is advantageous. Only high quality raw material should be used. Thorough homogenization and 5 hr. of aging are recommended. In freezing, the overrun should be kept under that of corresponding flavors of bulk ice cream. Every container should be of the same weight. The ice cream should be frozen to a stiff dry consistency and transferred to the hardening room quickly. The hardening time should be 6 to 8 hr. Appealing flavor and flavor combinations assist in promoting the sale of packaged ice cream. In addition to standard flavors, 2-layer, 3-layer and revel type of packages are desirable. The type of container from which ice cream must be dipped yields a product more like hand-dipped bulk ice cream, but this style of package lacks the ready serving convenience of the container which is

easily pulled away from the ice cream. Another important factor in the production of satisfactory packaged ice cream is the establishment of an adequate system of quality control. W.H.M.

90. Automatic ice cream packaging is here. ANONYMOUS. Ice Cream Trade J., *43*, 10: 98, 99, 164, 165. Oct., 1947.

Machines for packaging ice cream now are being manufactured by Anderson Bros. Mfg. Co., Rockford, Ill.; Pure-Pak Division, Ex-Cell-O Corp., Detroit, Mich.; Ray Industries, Los Angeles, Calif.; Frank D. Palmer, Inc., Chicago, Ill.; and Prestige Products Co., New York City.

Some of these machines already are being used commercially. Others have been fully tested and are ready for use in the plant. Still others are thoroughly tried refinements of earlier machines. All are designed to set up, fill, and seal various types of containers commonly used in the ice cream industry. All should play their part in ultimately permitting a more rapid rate of packaging with lower cost per unit and more sanitary handling. W.H.M.

91. A complete report of Breyer's experiences to date with the bulk gallon. A. L. HACKMAN, Breyer Ice Cream Co., Long Island City, N. Y. Ice Cream Trade J., *43*, 10: 94, 140, 141. Oct., 1947.

This company first introduced the 1-gallon container for bulk ice cream in the Harrisburg area on Nov. 1, 1945. The first month's sales represented 3.7% of the total sales, the second month 8%, and the third month 12%, which later dropped to 4–5% of total sales. Most dealers were in rural areas. Later the gallon container was introduced in Allentown and Scranton, Pa., Wildwood, N. J., and Salisbury, Md., with sales ranging from 2 to 5.5% of total sales. Experience in the New York area was not as satisfactory, with sales averaging 2%, compared to 4 to 10% in the Philadelphia area. Apparently there is a large consumer demand for bulk ice cream in gallon containers at a reasonable price. The retail price must appear on the container. Dealers are allowed a 20% mark-up. W.H.M.

92. Ice cream as a nutritious food. J. W. LAWRENCE. Can. Dairy Ice Cream J., *26*, 11: 37. Nov., 1947.

Ice cream contains almost 80% dairy products, in the form of milk, cream, and milk solids. An average serving of ice cream compares favorably in mineral and protein content with apple pie, rice pudding, chocolate layer cake, lemon meringue pie, and fruit cup, and is superior to these foods in many categories. An average serving of ice cream contains only 140 calories as against 300 calories in a normal serving of apple pie, 400 in a piece of chocolate layer cake and 450 in a slice of lemon meringue pie. Ice cream is placed in the category of protective foods, containing more

proteins, calcium, vitamin A and riboflavin than many desserts. The protein and mineral content of ice cream is more easily digested than that of other sources. At retail prices it compares favorably with many other staple foods. H.P.

93. Adding smaller markets. ANONYMOUS. Ice Cream Trade J., *43,* 10: 96, 138. Oct., 1947.

Since introducing Holly Carter brand of ice cream in Milwaukee and the Crestmont brand in Detroit, the A & P stores are selling ice cream in many smaller communities. In these small markets the stores are selling ice cream purchased from local manufacturers. The usual mark-up is about 22%. No figures are available at this time on sales volume. W.H.M.

94. Drive-in operations. H. J. MULDOON. Ice Cream Field, *50,* 5: 24–26. Nov., 1947.

The ideal spot for a drive-in is on the outskirts of the business district on a well-traveled thoroughfare used by local people on their way to and from the business district. For a drive-in with seating capacity of 32, a building $20' \times 45'$ on a lot $100' \times 165'$ with parking facilities for 40 cars is recommended.

Ice cream and products containing ice cream should be the main products sold. However, hamburgers and coffee also are essential to the best operation. Care in selecting help is stressed; young married women or divorcees with one or more children are recommended for car hops instead of boys or bobby sockers. Proper training and supervision of employees are emphasized, supervision constituting the most important phase of the whole operation. Labor and supervision costs amount to 20–22%, which is higher than for most inside stores. However, to do the same volume of business with an inside store would require about double the investment required for a drive-in. Customer advantages and complaints and operator advantages and complaints are listed. W.C.C.

95. Planning the operation of retail drive-in ice cream stores. O. H. GLAZIER. Ice Cream Trade J., *43,* 11: 66, 67, 92, 93, 94. Nov., 1947; also Ice Cream Rev., *31,* 5: 74, 76, 78, 80, 82. Dec., 1947.

The location should provide ample space for the parking of cars and a pleasant background. The stand should be located on the edge of the residential area rather than on a main traffic artery. There may be exceptions to this rule, such as a location that has an unusully attractive background or something of great interest near the stand that people will want to stop and see.

The building should be designed correctly, in proper proportion and in harmony with its surroundings. Some landscaping in the form of shrubs

or flower gardens helps to create the desired impression. Two dipping cabinets arranged at right angles to the front windows are desirable. One should be set at 10° F. for lower melting ice cream like chocolate and fruit ice cream and the other at 14° F. for the higher melting plain ice creams. Paper cups and dishes are best adapted to his type of business because they eliminate washing and breakage. Ample storage space should be provided. A direct expansion ammonia batch freezer is recommended, or a continuous freezer might be considered if some wholesale business is done. Storage space for cones, dishes and fountain supplies should be provided in the stand. No stand is complete without a fountain, and it should be of the proper size for the building. Mixers for milk shakes also are needed. Good wooden spoons and individually wrapped straws help to create good customer impressions.

Personnel must be chosen with care by a process of elimination. The author has had best experience with young men 18 to 25 years of age. They are faster, understand how to do things without being told all the smaller details, and do not get confused as easily in making change and in filling complicated orders during a rush.

Limit sales to ice cream and soda bar products such as sodas, sundaes and milk drinks. High-quality products sold in a friendly manner in pleasant surroundings for a fair price are the best insurance for the success of any retail ice cream store. W.H.M.

96. Costs, prices, profits. A frank analysis of the industry's position today. V. F. HOVEY, General Ice Cream Corp., Schenectady, N. Y. Ice Cream Trade J., *43*, 10: 84, 85, 145–147. Oct., 1947.

The cost of making ice cream in Sept., 1947, increased 11.5¢ per gallon over the Sept., 1946, costs, with no allowance for difference in volume. This 11.5¢ is made up of 4¢ for material, 4¢ for labor, 0.5¢ for depreciation and 3¢ for other items.

Some manufacturers may try to cut costs by increasing overrun. However, the author believes this is a mistake. A reduction in volume of sales will have a marked effect on cost. Figures indicate that a decrease of 10% in volume will result in an increase in cost of about 3¢ per gallon; a 20% decrease in volume increases the cost about 6¢ per gallon.

Since the consumer price is so closely related to consumption, manufacturers may have to print retail prices on their packages unless retailers voluntarily keep percentages of profit at a reasonable level. A sound price structure with a discount scale providing a difference in price to large and small customers, at least on bulk ice cream, equal to the difference in costs of serving them, is advocated. Manufacturers should have printed price lists to which they adhere so that each manufacturer knows the basis upon which competitors solicit business. The discounts to be given to any cus-

tomer should be determined only at the close of the year when his actual gallonage is known. W.H.M.

97. Frozen dessert composition. S. MUSHER. U. S. Patent 2,431,704, Dec. 2, 1947 (7 claims). Official Gaz. U. S. Pat. Office, *605*, 1: 66. 1947.

As a means of controlling the overrun, avoiding bleeding and improving the texture and body of sherbets, ices and ice cream, a stabilizer consisting of oat flour is recommended. To obtain optimum results, a premix should be prepared by blending the oat flour, gelatin if used, part of the sugar and some of the water or milk of the mix and heating to at least 175° F. and preferably to 190–220° F. This mixture then is combined with the other ingredients of the mix prior to pasteurization. About 1% of the total mix should be oat flour. R.W.

98. Ice cream and ice cream mix. T. B. HIPPLE AND S. S. SADTLER. U. S. Patent 2,433,276, Dec. 23, 1947 (8 claims). Official Gaz. U. S. Pat. Office, *605*, 4: 677. 1947.

A dry powder, suitable for making ice cream mix, is prepared by spray drying a mixture of hydrogenated butterfat, cream and soya protein. R.W.

MILK

99. The freezing point of milk: Some recent developments F. J. MACDONALD. Dairy Inds., *12*, 9: 846–851. Sept., 1947.

The developments that have taken place since the early work of Dreser in 1892 on the freezing point of milk and its application are discussed. The average freezing point of 480 samples of milk taken from tank car shipments over a period of 2 years was – 0.544° C. This figure agrees with those previously reported by most investigators.

Mastitis milk has essentially the same freezing point as normal milk, while the development of acidity increases the depression of the freezing point. The use of formalin also increases the depression of the freezing point but can be corrected for by calculation. Data from previously published work show the amount of correction required when various amounts of formalin are added. D.V.J.

100. L'irradiation du lait aux Estats-Unis. (The irradiation of milk in the United States.) C. WOLF. Lait, *27*, 265–266: 238–257. May–June, 1947.

Irradiation methods and literature in the United States up to June, 1939, are reviewed. In a supplementary note, standards and practices adopted since that date are described. O.R.I.

PHYSIOLOGY

101. Why hormone treatments sometimes fail. C. F. CAIRY. J. Am. Vet. Med. Assoc., *112,* 850: 30–33. Jan., 1948.

The infancy and complexity of the hormone field make it a dangerous one for inexperienced workers. The lack of fundamental physiologic knowledge is one of the serious handicaps of hormone therapy. The exact nature of hormones and their specific action in the animal body still are unknown. Certain precautions are fundamental in any hormone therapy. Make as complete a diagnosis as possible. Evaluate environmental and clinical factors which may have same symptoms as hormone dysfunction. Use only products whose strength has been determined. Dosage is most important, since excesses often produce opposite effects. Keep up on species differences. T.M.L.

SANITATION AND CLEANSING

102. Some aspects of detergency involving surface chemistry and physics. J. C. L. RESURGGAN, The British Hydrological Corp. Dairy Inds., *12,* 9: 852–855. Sept., 1947.

The fundamental chemical and physical aspects of detergency are discussed. The process cannot be defined in terms of either physics or chemistry alone, since many of the physical effects are dependent upon chemical reactions in the detergent solution or at the interface between the solution and the deposit. The subject is discussed in the light of established physical laws and chemical reactions and the parts they play in the complex forces involved in the removal of deposits from metals, glass and plastics.

D.V.J.

103. Cleansing of dairy utensils. III. Results of the bacteriological examination of rinses and swabs of farm dairy utensils. S. B. THOMAS, P. M. HOBSON, C. G. JONES, E. JONES-EVANS, AND J. C. DAVIES. Dairy Inds., *12,* 11: 1095–1099. Nov., 1947.

This investigation was undertaken to study the "rinse" and "swab" techniques of checking washed utensils on English dairy farms. Two types of farms were studied, namely, control farms using routine steam sterilization of utensils and Category C farms (600 in number) which frequently produced reject class milk.

Over 87% of rinses on control farms showed less than 50,000 bacteria, while only 31% of the Category C farms fell in this class. With swab tests, 88% of the control farms had colony counts under 5,000 per sq. ft. as compared with 27% for the Category C group. Results showed that 50% of utensils on Category C farms were grossly contaminated. The authors conclude that the swab technique is in many ways superior to the rinse method.

D.V.J.

104. Germicidal effect of quaternary ammonium compounds on dairy organisms. R. V. HUSSONG. Can. Dairy Ice Cream J., *26,* 11: 92. Nov., 1947.

The advantageous properties the quaternary ammonium compounds possess for germicidal purposes are that they are soluble in water, non-corrosive, non-toxic, chemically stable, have rapid killing action, are non-volatile, are practically odorless and tasteless, are wetting agents, and have high germicidal action on test organisms used. One disadvantage of these compounds is that they are not compatible with certain alkalis and soaps used in the dairy plants. If surfaces are not rinsed free of the non-compatible materials, they may neutralize the effect of the quaternary compounds. Experimental results indicate that Roccal, Ster-Bac, Emulsept, and Isothan all were effective against *Streptococcus lactis* and *Staphylococcus aureaus* and against two species of yeasts, *Torula cremoris* and *Torula sphaerica.* H.P.

105. Control of insects and rodents in food plants. G. C. DECKER. Can. Dairy Ice Cream J., *26,* 11: 78. Nov., 1947.

See Abs. 134. J. Dairy Sci., *30,* 4: A61. April, 1947.

MISCELLANEOUS

106. What the Federal Food and Drug is looking for. C. T. HUBBLE, Minneapolis Station, Food and Drug Administration. Natl. Butter Cheese J., *39,* 1: 42, 44, 46. Jan., 1948.

The Federal Food, Drug and Cosmetic Act of 1938 differs significantly from the Act of 1906 in requiring that foods be manufactured under sanitary conditions. The terms of the Act are general and are not restricted to conditions affecting the health of the consumer. Inspectors of food plants are instructed to point out failures in sanitary control to interested manufacturers. The sediment test for insoluble material and the methylene blue test for bacterial load are practical tests applied to examine the condition of milk. Penalties for violation may include seizure of the product, criminal prosecution of those responsible for violations, or injunction to cease violating the law. Fines and prison sentences may be imposed. W.V.P.

107. One dairy plant operator influences 844 farmers. ANONYMOUS. Natl. Butter Cheese J., *39,* 1: 30, 31, 64. Jan., 1948.

A survey of representative members of the dairy industry in 27 different states disclosed that 98% of them sell supplies and equipment to farmer patrons. Such sales are made to provide desirable facilities and to give fieldmen the chance to demonstrate proper methods of production. Over half of the sales are made at cost; 42% are made at regular retail prices.

Washing powders, filter discs, milk strainers, milk cans, brushes, insect sprays and sterilizers are the items most commonly handled. W.V.P.

108. Practical training for dairy technologists. C. K. JOHNS. Can. Dairy Ice Cream J., *26,* 12: 21. Dec., 1947.

Theoretical knowledge is necessary but it must be supplemented by a good background of practical experience. The average college graduate was found to lack practical experience. The dairy industry must recognize that the provision of practical training is primarily its responsibility. If the dairy industry is to obtain the right type of man for positions of responsibility, some thought should be given to a program of student training. The need for well-trained men will increase from year to year. H.P.

109. West coast dairy cooperative tests key men on supervision. ANONYMOUS. Food in Canada, *7,* 7: 15–18. July, 1947.

During the winter months the Okanogan Valley Cooperative Creamery Association conducts classes designed to impress foremen and supervisors as to the importance of good public relations and the necessity of careful supervision of employees. A series of 50 questions dealing with practical problems in these fields are presented in the article. Many of the questions present a number of alternative situations designed to allow the employee to appraise himself for positions of management. O.R.I.

110. New type refrigerator car requires no ice. E. M. HOLLER. Food in Canada, *7,* 7: 20–22. July, 1947.

A new type of railroad refrigerator car employing an absorption ammonia system for cooling is illustrated and described. Tanks holding 1,900 lb. of liquid anhydrous ammonia are slung beneath the car. The flow of ammonia to the expansion coils in the car ceiling is controlled by bulb-type temperature control apparatus. Later the ammonia is absorbed in water in a tank slung below the car. In the test reported, the car maintained temperatures at approximately 0° F. for a 10-day trial in which the car was held in a test house at 90° F. The car was fully loaded with frozen foods and these remained in a satisfactory condition. Costs for operating this type of equipment have not been determined. O.R.I.