A STUDY OF THE ACCURACY OF TESTING MILK FOR BUTTERFAT USING SAMPLES WITH AND WITHOUT CHEMICAL PRESERVATIVES

by

Ralph R. Taylor

A Thesis Submitted to the Faculty of the

DEPARTMENT OF DAIRY SCIENCE

In Partial Fulfillment of the Requirements

For the Degree of

MASTER OF SCIENCE

In the Graduate College

UNIVERSITY OF ARIZONA

1961

ACKNOWLEDGEMENTS

The writer wishes to express his sincere appreciation to the following members of the faculty of the University of Arizona for their valuable suggestions and assistance in the preparation of this manuscript: Dr. J. W. Stull, Professor of Dairy Science, Dr. V. R. Smith, Head, Department of Dairy Science and Dr. Henry Tucker, Statistician, College of Agriculture.

The cooperation of Shamrock Dairy in the collection of the samples was greatly appreciated.

A grant from the Arizona Dairymen's League aided in the financial support of this project. In January, 1960, a merger of the Arizona Milk Producers and the Arizona Dairymen's League brought about a new organization which is now called the United Dairymen of Arizona.

STATEMENT BY AUTHOR

This thesis has been submitted in partial fulfillment of requirements for an advanced degree at the University of Arizona and is deposited in the University Library to be made available to borrowers under the rules of the library.

Brief quotations from this thesis are allowable without special permission, provided that accurate acknowledgement of source is made. Requests of permission for extended quotation from or reproduction of this manuscript in whole or in part may be granted by the head of the major department or the Dean of Graduate College when in their judgement the proposed use of the material is in the interests of scholarship. In all other instances, however, permission must be obtained from the author.

SIGNED: Ralph R Taylor

APPROVAL BY THESIS DIRECTOR

This thesis has been approved on the date shown below:

J. W. Stull
Professor of Dairy Science

4 April 1961
Date

TABLE OF CONTENTS

LIST OF TABLES

CHAPTER I

INTRODUCTION

A preserved composite sample of milk is made by taking an aliquot from a producer's milk each delivery and placing it in a sealed container with a chemical preservative. The daily aliquots are combined with the accumulated portions for a period of five to fifteen days. The purpose of the preservative is to retard or prevent microbiological decomposition during storage with or without refrigeration. Materials that have been used for preservation include mercuric chloride, potassium dichromate, potassium chromate, Milkeep[1], Mojonnier test fluid[2], alum, sodium chloride and formalin.

By the composite method, only one sample is tested over a period of time, as compared to the necessity of testing a sample for every delivery. The composite test is applied to the total amount of milk delivered during the period. This method, therefore, has been popular from an economic laborsaving standpoint. In more recent years, extensive use of refrigeration and new preservatives has made it possible to improve the accuracy and efficiency of sampling methods.

---

[1]The chemical composition of this preservative is disodium phosphate-3,5-dimethyl tetrahydro-1,3,5 2H-thiadiazine-2 thione.

[2]The chemical composition of this preservative is not available.

Composite milk samples stored with a preservative usually show a somewhat lower fat test than daily samples. This difference is thought to be due to lipolytic hydrolysis. It is postulated that hydrolyzed fat will not be measured by conventional analytical methods. The preservatives currently used do not significantly retard fat hydrolysis. Preservatives supposedly do not affect the accuracy of the fat test. In some cases, composite samples without preservatives have been stored with refrigeration only. A periodic sample is one that is taken on designated days and usually tested the same day.

This study was designed to compare the accuracy in the application of the Babcock test for butterfat in raw whole milk received at a milk processing plant from a dairy farm. The fat test was applied to composite samples with and without added preservatives and compared with those obtained by daily analysis. Results from these were also compared to periodic tests at intervals of three, four and five times per month.

CHAPTER II

REVIEW OF LITERATURE

There is a lack of published information comparing the relation between the newer sampling methods and accuracy of butterfat tests for raw milk from producers. Composite samples stored with or without preservatives and periodic daily tests have been used in commercial practice. There are no reports in the literature comparing the accuracy of testing by using composite samples stored with and without preservatives and periodic tests.

In early research, Farrington (6)[1] and Cooke and Hills (3) compared daily samples and composite samples. Farrington compared three seven-day composite samples stored at room temperature of 64-91° F. with daily samples. The first composite sample was made from aliquot portions of milk each day and was preserved with a mixture of alum, mercuric chloride and table salt. The second sample contained a constant volume of milk taken each day and used the same preservative. The third composite sample also contained a constant volume of milk taken each day but used no preservative. The first composite sample tested 3.93%, the second 3.96%, the third 3.95% and the daily samples averaged 3.91%. He concluded that composite samples gave an accurate test of the butterfat in milk. He did not state if these differences

[1] The numbers in parenthesis refer to literature cited.

were significant, only that composite samples were sufficiently accurate. Cooke and Hills compared the tests from periodic samples taken every fourth and eighth day with tests from daily samples. They reported that there was less variability in sampling every fourth day versus every eighth day.

England and D'Ambrogi (4) found that, regardless of the length of time stored (7-15 days), temperature of storage (45-100° F.) or the amount of preservative used ($\frac{1}{2}$-2 tablets), the average fat test of composite samples was .093% lower than that of daily samples. They did not state if this difference was of significance.

Tracy and Tuckey (19) observed a difference between daily samples and seven-day composite samples preserved with mercuric chloride in a winter and a summer trial. They found in all cases that the tests from the daily samples averaged higher than the composite samples stored at 40° F. In the winter trial (divided in two parts), the tests from the daily samples averaged .061% higher than the composite samples in the first part and .026% higher in the second part. In the summer trial, the daily samples averaged .020% higher than the composite samples. They concluded that "tests on composite samples properly taken and stored would give an accurate measurement of the fat content of milk".

Wilster and Roubichaux (20) found that tests from five, seven and fifteen-day composite samples preserved with mercuric chloride averaged .016%, .021% and .027% lower, respectively, than daily samples. They stated that these values were not significant. The composite samples were stored at 35-40° F.

Meade and Leckie (16) compared composite samples preserved with mercuric chloride and periodic samples of milk during a 151 day period. Three preserved composite samples were taken monthly with each period covering ten days. Periodic samples were tested on three days during each month at approximately equal intervals. The tests from periodic samples averaged .09% higher than the tests of the composite samples. The significance of this value or the temperature of storage was not stated.

Manus and Bendixen (14) performed studies on the effectiveness of a number of preservatives. They also included composite samples without preservatives. In each case the samples were stored for seven days at 35-38° F. They concluded that the reduction in fat test appeared to be due to lipolytic hydrolysis. In 1959, while the data in this study was being analyzed, Manus and Bendixen (15) found that the preservatives potassium dichromate, potassium chromate, Milkeep and Mojonnier test fluid gave results which were not different at the one per cent level of significance. Samples preserved with mercuric chloride had a significantly lower fat test and a higher free fatty acid titer. The samples were stored at 35-38° F. for one to two weeks.

Lucas (13) compared daily samples, composite samples preserved with mercuric chloride and periodic samples taken at random four and eight times per month. He found that tests from daily samples averaged .11% higher than preserved composite samples. He did not indicate if this value was significant. There was no significant difference between the tests of periodic samples taken eight times per month and

daily samples. He stated that periodic samples taken four times per month showed variations great enough to discredit the method.

Sammann and Overman (18) compared daily tests, tests from composite samples preserved with mercuric chloride and periodic tests. They concluded that "composite samples properly taken and stored would yield accurate results in testing whole milk". They also reported that the average for five one-day tests taken at equal intervals during the month gave a closer approximation to the true average fat content of milk than the average of four tests. They failed to state the temperature at which the composite samples were stored.

Campbell et al. (2) used two trials in which 1500 daily samples and 100 fifteen-day composite samples preserved with mercuric chloride were tested. They found the tests from daily samples averaged .03% higher in the first trial and .01% higher in the second trial than preserved samples. They did not indicate whether these differences were significant or the temperature at which the composite samples were stored.

Hunziker (8) studied tests from daily samples and fourteen-day composite samples preserved with mercuric chloride. The daily samples tested .035% higher than composite samples. He did not relate the temperature of storage or the preservative used. He also tested periodic samples taken every second, third, fourth and fifth days. It was observed that the test of periodic samples taken every fourth day was closer to the average daily test than were the others. He stated that preserved composite samples should not cover a period of more than seven days.

Judkins (10) contrasted daily samples, periodic samples taken twice and three times per month, and fifteen-day composite samples preserved with mercuric chloride. He reported that tests from samples taken three times per month averaged .02% lower than daily samples, while samples taken twice per month averaged .10% lower. The tests from preserved composite samples averaged .045% higher than the daily samples. He did not discuss whether these differences were significant or the temperature at which the composite samples were stored.

Kent (11) observed that thirteen-day composite samples stored with mercuric chloride at room temperature tested .035% lower than daily samples. He did not report on the significance of this value or the temperature at which the composite samples were stored.

Monroe (17), while studying seven-day composite samples preserved with mercuric chloride and daily samples, observed that composite samples tested .09% lower than daily samples. He did not state whether this was of significance or the temperature at which the composite samples were stored.

Herrmann *et al.* (7), in a study of sampling methods, compared periodic samples, samples preserved with mercuric chloride and daily samples. They found that approximately two out of three single daily samples fell within .2% of the producers' monthly weighted average butterfat percentage. The range of variation was only one-half as great when four daily samples were averaged. They observed that ten-day preserved composite samples stored at 48-50° F. tested significantly lower than the daily samples. The ten-day composite samples tested .039%

lower and the fifteen-day composite samples tested .060% lower than the daily samples.

Erdmann (5) compared the accuracy of testing periodic, daily and composite samples. He reported that the fat test for 92% of the periodic samples taken four times per month did not vary more than .05% from the mean. The mean was taken from the average of the daily tests. In comparing the tests from the composite and daily samples he found that the seven, ten and fifteen-day composite samples tested .03%, .02% and .02% lower, respectively, than daily samples. He did not report whether these values were significantly different from the tests of the daily samples. He stated that the composite samples were stored under refrigeration but did not indicate the temperature. He did not relate whether a preservative was used.

In reviewing the literature on preservatives, Jackson (9) found that mercuric chloride was best suited for preserving milk samples. He concluded from his experimental work that .05 grams would keep a 150 cc. sample of milk for fifteen days at room temperature. He also found that an excessive amount of mercuric chloride was not responsible for abnormal tests.

CHAPTER III

PROCEDURE

In this study, milk samples were collected daily during four thirty day sampling periods representing approximately four seasons of the year. The periods were February 20 through March 21, April 14 through May 13, June 13 through July 12 and September 20 through October 19. Ten producers of Grade A raw milk were randomly selected from the Salt River Valley (Arizona) milkshed. Using approved commercial procedure, the tank truck driver collected the samples daily from the farm bulk tank of each producer. The samples were then placed under refrigeration in shaved ice and shipped via milk transport to the milk plant in Tucson. They were then taken to the University of Arizona for testing in duplicate by the standard Babcock method (1). Each daily sample was analyzed for butterfat on arrival at the University.

A nine milliliter portion of the daily sample was used to prepare each of the composite samples which consisted of two seven-day preserved composite samples, two fifteen-day preserved composite samples and one six-day composite sample without a preservative. The composite samples were placed in a glass eight ounce plastic screw cap container and kept at 35-38° F.

The preservatives compared were Milkeep and mercuric chloride. The mercuric chloride used contained 45.9% bichloride of mercury and

the Milkeep contained 100% disodium phosphate-3,5-dimethyl tetrahydro-1,3,5 2H-thiadiazine-2 thione by the manufacturers' labels. In the seven-day preserved composite samples, one tablet of mercuric chloride and one tablet of Milkeep was used in the appropriate containers. In the fifteen-day composite samples, two tablets were used. The labels indicated that the mercuric chloride and Milkeep tablets weighed 356 and 325 milligrams, respectively.

For comparison with the daily and composite tests, periodic tests were used at intervals of three, four and five times per month. The daily tests corresponding to the appropriate days were used. For three periodic tests a month, the tenth, twentieth and thirtieth days were used. In the case of four periodic tests, the days used were the seventh, fourteenth, twenty first and twenty eighth. For five per month, the sixth, twelfth, eighteenth, twenty fourth and thirtieth days were used.

Daily milk weights were taken by the tank truck driver at the farm bulk tank. The manufacturer supplied an individual stainless steel measuring rod and calibration chart for each tank.

CHAPTER IV

DISCUSSION OF RESULTS

The butterfat tests and milk weights are given in the Appendix. The results of this study are summarized in Table One. To make a comparison of the various methods for all seasons a column of averages is included. Statistical analysis using the Multiple Range Test to group means with unequal number of replications (12) indicates no significant difference among the averages of the five sampling and testing methods. The variances for the sampling periods were taken from the pooled variance in the analysis of variance. It was observed that the variance of the fall sampling period was greater than the variance of the other sampling periods. This is possibly due to the fact that, in Arizona, many cows freshen in the fall of the year. During the first two weeks of the lactation period, milk has a characteristically higher per cent fat than during the rest of the lactation period.

Small variations were evident within the seasonal sampling periods. In comparing the tests from seven-day composite samples taken during the summer sampling period, the mercuric chloride sample was found to have a significantly lower test than either the Milkeep sample or the daily sample. During the same period the six-day composite sample stored without preservative tested significantly lower than the daily

TABLE ONE

AVERAGE PERCENT BUTTERFAT FOR PERIODIC SAMPLING, DAILY SAMPLING AND COMPOSITE SAMPLING WITH AND WITHOUT PRESERVATIVES

Type of Sample	Sampling Period				Average
	Fall	Winter	Spring	Summer	
	(%)	(%)	(%)	(%)	(%)
Seven-Day Preserved Composite ($HgCl_2$)	3.72	3.64	3.61	3.79	3.69
Seven-Day Preserved Composite (Milkeep)	3.75	3.63	3.62	3.84	3.71
Daily	3.74	3.63	3.63	3.85	3.71
Fifteen-Day Preserved Composite ($HgCl_2$)	3.70	3.62	3.59	3.82	3.68
Fifteen-Day Preserved Composite (Milkeep)	3.74	3.61	3.61	3.85	3.70
Daily	3.75	3.63	3.63	3.85	3.72
Six-Day Composite (Not Preserved)	3.74	3.65	3.66	3.81	3.72
Daily	3.75	3.63	3.63	3.85	3.72
Periodic Taken 3 Times Per Month	3.82	3.65	3.63	3.84	3.74
4 Times Per Month	3.80	3.64	3.61	3.91	3.74
5 Times Per Month	3.78	3.62	3.64	3.85	3.72
Daily	3.75	3.63	3.63	3.85	3.72
Average of Pooled Variances	.0410	.01035	.01279	.00920	-

sample. The periodic sample taken four times per month showed a significantly higher test than the periodic sample taken either three or five times per month in the summer sampling period. The variations that occurred in the summer sampling period only might be explained from the standpoint of higher environmental temperature. Many times this temperature was 90° F. or higher. There were indications that during shipment the ice did not last long enough to keep the samples from warming to the point of partial fat churning. When this phenomenon occurred particles of churned fat clung to the sides of the sample bottle. Even by using recommended procedures of sample preparation it was difficult to bring the fat into complete, uniform suspension.

From the results it appears that, under normal conditions, the most economical method would be by periodic sampling and testing three times per month. Since accuracy as well as economy of testing is a factor, both the periodic samples taken five times per month and the six-day fresh composite samples most closely approximated the true per cent fat obtained by daily analysis. While there is no difference in the number of actual tests needed, there is a difference in sampling time required due to the procedure. With the composite method, a sample must be collected and placed into a container, agitated and refrigerated each day for a period of six days and then tested. This involves a certain amount of labor in taking and handling the samples. The five times per month periodic method requires sampling and testing every sixth day only. A comparison of the six-day composite samples and the periodic samples taken five times per month shows quite readily that,

from the cost and convenience standpoint, the periodic sample taken five times per month would be more favorable.

The results of this study varied slightly from some reports in the literature. England and D'Ambrogi (4), in research which dealt with a large number of variables including storage temperatues of 45, 60, 80 and 100° F., found that samples stored above 60° F. were much lower in test than those stored below this temperature. When samples were stored at 45° F. the daily samples averaged .064% higher than preserved composite samples stored for seven days. They did not state whether these differences were significant. They observed that the tests from fifteen-day composite samples stored at 45° F. averaged .051% lower than daily samples. In this study, where all composite samples were stored at 35-38° F., tests from seven-day preserved composite samples averaged .02% lower than the daily samples and the fifteen-day composite samples preserved with mercuric chloride were .04% lower than the daily samples. These differences were not found to be significant.

Lucas (13) found that tests from preserved composite samples averaged .11% lower than the daily samples. He did not indicate whether this was significant statistically and also did not relate the temperature at which the samples were stored. Monroe (17), while studying seven-day composite samples preserved with mercuric chloride and daily samples, observed that composite samples tested .09% lower than daily samples. He did not state whether this was of significance or the temperature at which the composite samples were stored. In a comparison of preserved composite samples and periodic fresh samples,

Meade and Leckie (16) found the periodic samples tested .09% higher than the preserved composite samples. Manus and Bendixen (14) found that composite samples preserved seven days with mercuric chloride exhibited a significantly lower test than composite samples without added preservative while stored at 35-38° F. In this study, the six-day composite samples without preservative tested .03% higher than the seven-day composite samples preserved with mercuric chloride and .04% higher than the fifteen-day preserved composite samples preserved with mercuric chloride. When comparing the two preservatives, Milkeep and mercuric chloride, they (15) observed that the mercuric chloride yielded results which were significantly lower. In this study, the mercuric chloride samples produced a lower test than the Milkeep samples but not low enough to be of significance.

Only two workers, Judkins (10) and Farrington (6), found that composite samples tested higher than daily samples. Farrington observed that seven-day preserved composite samples, taken in aliquot, tested .02% higher than the daily samples. The preserved composite samples taken in constant volume each day tested .05% higher than daily samples. The composite samples without preservatives tested .04% higher than daily samples. Judkins found that fifteen-day preserved composite samples tested .045% higher than daily samples. In this study, seven-day composite samples preserved with mercuric chloride tested .02% lower than daily samples while fifteen-day composite samples preserved with mercuric chloride tested .04% lower than daily samples. Judkins also found that periodic samples taken three times per month averaged .02%

lower in test than daily samples. Periodic samples taken twice per month tested .10% lower than daily samples. Periodic samples taken twice per month were not used in this study, however tests from periodic samples taken three times per month averaged .02% higher than tests from daily samples. Neither worker stated whether the differences found were significant or the temperature at which the composite samples were stored.

On the other hand, there was close agreement between the results of this study and some other reports in the literature. Tracy and Tuckey (19) observed a difference between daily samples and preserved composite samples stored for seven days at 40° F. In all cases they found daily samples testing from .02% to .064% higher than the preserved composite samples. They did not state whether these values were great enough to be of significance. In a study by Wilster and Roubichaux (20) comparing fresh daily samples and preserved composite samples stored for five, seven and fifteen days at 35-38° F., they found composite samples tested lower than daily samples. The five-day composite samples tested .016% lower, the seven-day .021% lower and the the fifteen-day .027% lower than the daily samples, but the differences were not large enough to be significant. In this study, seven-day composite samples preserved with mercuric chloride tested .02% lower and the fifteen-day composite samples tested .04% lower than daily samples. In two trials comparing daily samples with fifteen-day preserved composite samples at room temperature, Campbell, Jaggard and Morris (2) found that fifteen-day preserved composite samples tested .02% lower

than daily samples. They did not report on the statistical significance of the differences found.

Lucas (13) reported in a comparison of periodic samples taken four and eight times per month and daily samples that the difference was not sufficient to be significant. In the same type of comparison, Sammann and Overman (18) found that periodic samples collected five times per month more closely approximated the true butterfat percentage than those taken four times per month as was also the case in this study.

In comparing daily tests and fourteen-day preserved composite tests, Hunziker (8) found that the daily samples tested .035% higher than the composite samples. He did not indicate the temperature of storage or whether the difference cited was significant. In testing periodic samples taken every second, third, fourth and fifth day, he found samples tested every fourth day averaged closer to the daily test than did the others. Kent (11) observed that thirteen-day composite samples preserved with mercuric chloride and stored at room temperature tested .035% lower than daily samples. In this study the fifteen-day composite samples preserved with mercuric chloride tested .04% lower than daily samples. Periodic samples taken every six days were more accurate than periodic samples taken every eight and ten days.

Herrmann et al. (7) in a study of sampling methods compared periodic, preserved composite and daily samples. They found that "approximately two out of three single daily samples fell within .2 of the producers' monthly weighted average butterfat percentage". The

range of variation was only one-half as great when four daily samples were averaged. They observed that ten-day preserved composite samples tested significantly lower than the daily samples. The ten-day composite samples tested .039% lower and the fifteen-day samples tested .060% lower than daily samples. The composite samples were stored at 48-50° F. Erdmann (5) found composite samples tested lower than daily samples. Seven-day composite samples were .03% lower, the ten-day composite samples were .02% lower than daily samples. He did not report whether these values were significant. He stated that the composite samples were refrigerated but did not report the temperature. In this study, ten-day composite samples were not used, but seven-day and fifteen-day composite samples preserved with mercuric chloride tested .02% and .04% lower, respectively, than daily samples.

In early work, Cooke and Hills (3) compared periodic samples taken every fourth and eighth day with daily samples. They reported that there was less variability in sampling every fourth day as opposed to sampling every eighth day. Results of this study also have shown that the more frequent sampling gives greater accuracy.

CHAPTER V

CONCLUSIONS

In this study, fat tests were compared using daily samples, six-day composite samples without preservative, seven and fifteen-day preserved composite samples and periodic samples taken three, four and five times per month. The results show that:

1. There was greater variability in the summer sampling period than during other sampling periods. In the summer sampling period the average test of the seven-day composite samples preserved with mercuric chloride was significantly lower than either the seven-day composite samples preserved with Milkeep or the daily samples. Also in the summer sampling period, the average of the six-day composite samples without preservative tested significantly lower than the daily samples. The periodic samples taken four times per month tested significantly higher than the daily samples in the summer sampling period.

2. There were no significant differences between various values in the fall, winter or spring period.

3. The larger variance found in the fall sampling period is thought to be due to the freshening of a larger number of cows than is the case during the other periods of the year in Arizona.

4. In averages taken from the four sampling periods, none of the differences were large enough to be significant.

5. The tests from daily samples were consistently higher than the tests from both the seven and the fifteen-day preserved composite samples in all sampling periods.

6. Seven and fifteen-day composite samples preserved with Milkeep consistently tested higher than seven and fifteen-day composite samples preserved with mercuric chloride.

7. Average tests from six-day composite samples without added preservative agreed exactly with tests from daily samples.

8. Periodic samples taken both three and four times per month tested consistently higher than daily samples in all sampling periods.

9. The average test from the periodic samples taken five times per month were identical to the average test of the daily samples.

LITERATURE CITED

1. Association of Official Agricultural Chemists. Official Methods of Analysis. 8th Ed., p. 248, 1955.

2. Campbell, H. C., Jaggard, George B., and Morris, Dewitt. Accuracy of the Composite Test. The Milk Dealer 21:42, 1931.

3. Cooke, W. W. and Hills, J. L. Creamery Work. Vt. Agr. Exp. Sta. Ann. Rept., 1891.

4. England, C. W. and D'Ambrogi, G. D. Some Factors Affecting the Accuracy of the Babcock Test on Composite Samples of Milk. Md. Agr. Exp. Sta. Bull. 413, 1937.

5. Erdmann, H. H. A Statistical Analysis of Butterfat Test of Milk Based on Random Fresh Milk Sampling. Fed. Milk Marketing Administrator, Chicago, Ill. 1950, 26 pp.

6. Farrington, E. H. Composite Milk Samples Tested for Butterfat. Ill. Agr. Exp. Sta. Bull. 16, 1891.

7. Herrmann, L. F., Bryan, W. G. and Anderson, E. Sampling Routine and the Accuracy of Patrons' Butterfat Tests. U. S. D. A. Marketing Research Report No. 66, 1954.

8. Hunziker, O. F. Report of the Dairy Husbandry Department. Ind. Agr. Exp. Sta. Ann. Rept. 27, 1914.

9. Jackson, H. C. The Effect of Corrosive Sublimate When Used as a Preservative in Composite Samples. J. Dairy Sci. 2:170, 1919.

10. Judkins, H. F. The Sampling of Milk. J. Dairy Sci. 4:350, 1921.

11. Kent, F. L. Testing Milk and Cream. Ore. Agr. Exp. Sta. Bull. 70, 1902.

12. Kramer, Clyde Young. Extension of Multiple Range Test to Group Means with Unequal Number of Replications. J. Biometric Society 12:307, 1956.

13. Lucas, P. S. Accuracy of the Composite Sample. Mich. Agr. Exp. Sta. Bull. 158, 1938.

14. Manus, L. J. and Bendixen, H. A. Effects of Lipolytic Activity and of Mercuric Chloride on the Babcock Test for Fat in Composite Milk Samples. J. Dairy Sci. 39:508, 1956.

15. Manus, L. J. and Bendixen, H. A. Effects of Some Preservatives on Babcock Tests and Fat Hydrolysis in Single Milk Samples. J. Dairy Sci. 42:1236, 1959.

16. Meade, Devoe and Leckie, J. N. To What Extent Do Tests from Composite Samples and Fresh Samples of Milk Agree? Milk Plant Monthly 25:28, 1936.

17. Monroe, C. F. Accuracy of Composite Milk Samples. Ohio Agr. Exp. Sta. Bull. 446, 1929.

18. Sammann, F. P. and Overman, O. R. Periodic Sampling Compared with Composite Sampling and the True Average Tests of Monthly Milk Deliveries. Creamery and Milk Plant Monthly 15:39, 1926.

19. Tracy, P. H. and Tuckey, S. L. Accuracy of Methods of Sampling Milk Deliveries at Milk Plants. Ill. Agr. Exp. Sta. Bull. 459, 1939.

20. Wilster, G. H. and Roubichaux, R. P. Sampling, Preserving and Testing Milk. Ore. Agr. Exp. Sta. Bull. 383, 1940.

APPENDIX

BUTTERFAT ANALYSIS FOR FALL SAMPLING PERIOD
(September 20 through October 19)

Daily Test (Day No.)	Producer No. 1 Fat (%)	Producer No. 1 Milk (lb.)	Producer No. 2 Fat (%)	Producer No. 2 Milk (lb.)
1	3.87	1858	3.83	5605
2	3.76	1836	3.83	5693
3	3.90	1915	3.82	5622
4	3.80	1919	3.79	5745
5	3.85	1985	3.80	5780
6	3.88	1994	3.86	5798
7	3.70	2029	3.69	5833
8	3.80	1985	3.78	5798
9	3.85	1985	3.49	5798
10	3.84	1915	3.73	5877
11	3.73	1946	3.78	6002
12	3.81	2959	3.77	5851
13	3.81	2919	3.82	5921
14	3.81	2033	3.77	5938
15	3.81	2029	3.68	6121
16	4.63	2719	3.70	1261
17	4.49	2685	3.67	7044
18	4.60	2697	3.82	6436
19	4.77	2661	3.78	6647
20	4.84	2645	3.83	3280
21	4.82	2521	3.73	3343
22	4.78	2541	3.80	3516
23	4.53	2581	3.73	6335
24	4.88	1880	3.84	5605
25	4.77	2573	3.73	6194
26	4.84	2589	3.70	5380
27	4.45	2494	3.80	3516
28	5.18	2641	3.69	3739
29	4.65	2641	3.66	3573
30	4.82	2732	3.72	4768

	Producer No. 1 Fat (%)	Producer No. 2 Fat (%)
6-Day composite (Not preserved)		
Day 1 through 6	3.75	3.80
Day 7 through 12	3.75	3.70
Day 13 through 18	4.82	3.70
Day 19 through 24	4.72	3.78
Day 25 through 30	4.82	3.72

	Producer No. 1		Producer No. 2	
7-Day composite (Preserved)	$HgCl_2$	Milkeep	$HgCl_2$	Milkeep
Day 1 through 7	3.72	3.80	3.73	3.75
Day 8 through 14	3.75	3.89	3.69	3.80
Day 15 through 21	4.65	4.65	3.73	3.78
Day 22 through 28	4.73	4.79	3.75	3.79

	Producer No. 1		Producer No. 2	
15-Day composite (Preserved)	$HgCl_2$	Milkeep	$HgCl_2$	Milkeep
Day 1 through 15	3.75	3.80	3.70	3.79
Day 16 through 30	4.58	4.69	3.68	3.75

BUTTERFAT ANALYSIS FOR FALL SAMPLING PERIOD
(September 20 through October 19)

Daily Test (Day No.)	Producer No. 3 Fat (%)	Producer No. 3 Milk (lb.)	Producer No. 4 Fat (%)	Producer No. 4 Milk (lb.)
1	3.53	2977	4.78	2394
2	3.53	3019	4.70	2453
3	3.55	3168	4.60	2385
4	3.58	1108	4.49	2457
5	3.55	5134	4.60	2371
6	3.55	3072	4.68	2412
7	3.65	3072	4.52	2425
8	3.54	3114	3.72	2430
9	3.58	3204	4.82	2539
10	3.53	3192	4.59	2439
11	3.50	3240	4.58	2453
12	3.54	4050	4.64	2457
13	3.52	4376	4.49	2439
14	3.52	3418	4.90	2430
15	3.53	3430	4.55	2439
16	3.24	3741	4.60	2439
17	3.26	3530	4.53	2493
18	3.11	15435	4.57	2511
19	3.34	17904	4.40	2453
20	3.34	15094	4.63	2507
21	3.30	17682	4.90	2371
22	3.38	15597	4.75	2434
23	3.51	15287	4.72	2376
24	3.36	16430	4.80	2348
25	3.51	15295	4.93	2335
26	3.19	17937	4.81	2299
27	3.11	17461	4.83	2299
28	3.22	18501	4.69	2217
29	3.38	17309	4.99	2303
30	3.46	16583	5.07	2272

	Producer No. 3 Fat (%)	Producer No. 4 Fat (%)
6-Day composite (Not preserved)		
Day 1 through 6	3.52	4.50
Day 7 through 12	3.52	4.56
Day 13 through 18	3.33	4.57
Day 19 through 24	3.33	4.77
Day 25 through 30	3.29	4.73

7-Day composite (Preserved)	Producer No. 3 $HgCl_2$	Producer No. 3 Milkeep	Producer No. 4 $HgCl_2$	Producer No. 4 Milkeep
Day 1 through 7	3.50	3.52	4.52	4.59
Day 8 through 14	3.50	3.60	4.65	4.73
Day 15 through 21	3.19	3.20	4.55	4.50
Day 22 through 28	3.29	3.31	4.73	4.73

15-Day composite (Preserved)	Producer No. 3 $HgCl_2$	Producer No. 3 Milkeep	Producer No. 4 $HgCl_2$	Producer No. 4 Milkeep
Day 1 through 15	3.50	3.55	4.62	4.63
Day 16 through 30	3.24	3.24	4.68	4.73

BUTTERFAT ANALYSIS FOR FALL SAMPLING PERIOD
(September 20 through October 19)

Daily Test (Day No.)	Producer No. 5 Fat (%)	Producer No. 5 Milk (lb.)	Producer No. 6 Fat (%)	Producer No. 6 Milk (lb.)
1	3.83	4442	4.78	2932
2	3.86	4556	4.70	2951
3	3.69	4516	4.65	2771
4	3.62	4711	4.76	2776
5	3.68	4674	4.55	2785
6	3.72	4556	4.70	2837
7	3.70	4585	4.72	2814
8	3.73	4533	4.70	2748
9	3.66	4571	4.89	2852
10	3.70	4366	4.95	2809
11	3.82	4526	4.79	2842
12	3.75	4373	4.63	2828
13	3.65	4250	4.87	2885
14	3.80	4304	4.92	2781
15	3.62	4389	4.85	3045
16	3.80	4320	4.75	2989
17	3.78	4158	4.80	2989
18	3.72	4204	4.87	2970
19	3.78	4028	4.72	2984
20	3.92	4020	4.90	2951
21	3.84	4035	5.00	3022
22	3.78	4105	5.07	2974
23	3.93	3974	5.10	2918
24	3.82	3928	5.15	2856
25	4.02	3725	5.04	2870
26	3.89	3851	5.05	2989
27	4.04	3613	4.98	2925
28	3.85	3807	5.19	2880
29	4.03	3644	5.19	2809
30	3.91	3703	5.30	2729

6-Day composite (Not preserved)	Fat (%)	Fat (%)
Day 1 through 6	3.70	4.60
Day 7 through 12	3.64	4.70
Day 13 through 18	3.74	4.83
Day 19 through 24	3.83	4.98
Day 25 through 30	3.95	5.08

7-Day composite (Preserved)	$HgCl_2$	Milkeep	$HgCl_2$	Milkeep
Day 1 through 7	3.62	3.62	4.60	4.62
Day 8 through 14	3.69	3.87	4.80	4.87
Day 15 through 21	3.77	3.73	4.85	4.78
Day 22 through 28	3.88	3.83	5.04	5.00

15-Day composite (Preserved)	$HgCl_2$	Milkeep	$HgCl_2$	Milkeep
Day 1 through 15	3.63	3.78	4.69	4.74
Day 16 through 30	3.78	3.84	4.97	4.98

BUTTERFAT ANALYSIS FOR FALL SAMPLING PERIOD
(September 20 through October 19)

Daily Test (Day No.)	Producer No. 7 Fat (%)	Producer No. 7 Milk (lb.)	Producer No. 8 Fat (%)	Producer No. 8 Milk (lb.)
1	2.99	1552	3.53	9052
2	2.98	1232	3.45	9260
3	2.98	1197	3.61	9230
4	3.10	1197	3.59	9285
5	2.97	1272	3.45	9321
6	2.87	1237	3.56	9069
7	3.02	1276	3.52	9173
8	3.13	1257	3.55	9168
9	3.17	1316	3.48	8791
10	3.09	1378	3.62	8834
11	3.23	1393	3.55	8821
12	3.16	1408	3.55	8924
13	3.03	1408	3.50	8960
14	3.23	1347	3.53	8938
15	3.09	1398	3.44	8915
16	3.15	1326	3.54	8958
17	3.12	1362	3.54	9011
18	3.19	1281	3.53	8667
19	3.03	1367	3.72	8939
20	3.32	1347	3.70	8883
21	3.23	1306	3.48	9060
22	3.04	1357	3.45	9153
23	3.11	1316	3.53	9204
24	3.13	1305	3.63	9036
25	3.42	1305	3.18	9033
26	3.17	1362	3.60	9059
27	3.24	1272	3.64	8990
28	3.39	1272	3.49	9068
29	3.27	1344	3.92	8960
30	3.28	1344	3.68	9014

	Producer No. 7 Fat (%)	Producer No. 8 Fat (%)
6-Day composite (Not preserved)		
Day 1 through 6	2.93	3.53
Day 7 through 12	3.13	3.50
Day 13 through 18	3.20	3.52
Day 19 through 24	3.14	3.57
Day 25 through 30	3.30	3.71

7-Day composite (Preserved)	Producer No. 7 $HgCl_2$	Producer No. 7 Milkeep	Producer No. 8 $HgCl_2$	Producer No. 8 Milkeep
Day 1 through 7	3.00	3.02	3.49	3.58
Day 8 through 14	3.13	3.20	3.59	3.59
Day 15 through 21	3.18	3.21	3.58	3.65
Day 22 through 28	3.23	3.20	3.62	3.56

15-Day composite (Preserved)	Producer No. 7 $HgCl_2$	Producer No. 7 Milkeep	Producer No. 8 $HgCl_2$	Producer No. 8 Milkeep
Day 1 through 15	3.05	3.15	3.49	3.56
Day 16 through 30	3.19	3.20	3.63	3.60

BUTTERFAT ANALYSIS FOR FALL SAMPLING PERIOD
(September 20 through October 19)

Daily Test (Day No.)	Producer No. 9 Fat (%)	Producer No. 9 Milk (lb.)	Producer No. 10 Fat (%)	Producer No. 10 Milk (lb.)
1	3.63	1148	3.75	1863
2	3.50	1201	3.89	1730
3	3.45	1166	3.78	1704
4	3.53	1090	3.33	1721
5	3.83	1059	3.30	1833
6	3.47	1118	3.93	1695
7	3.39	1114	3.80	1546
8	3.44	1199	3.79	1630
9	3.50	1148	3.64	1586
10	3.55	1114	3.03	1919
11	3.69	1176	2.85	1884
12	3.72	1223	2.83	2031
13	3.65	1104	3.74	1621
14	3.38	1179	3.10	1820
15	3.58	1153	3.45	1738
16	3.54	1123	3.22	1803
17	3.68	1119	3.20	1790
18	3.57	1160	3.14	1811
19	3.20	1200	3.13	1927
20	3.53	1196	3.38	1854
21	3.73	1262	3.20	1777
22	3.72	1253	3.10	1833
23	3.67	1176	3.42	1616
24	3.58	1239	3.30	1252
25	3.74	1178	3.53	1586
26	3.78	1209	2.98	1893
27	3.86	1169	3.09	1734
28	3.83	1278	3.33	1379
29	3.79	1272	3.53	1656
30	3.83	1274	3.50	1602

	Fat (%)	Fat (%)
6-Day composite (Not preserved)		
Day 1 through 6	3.53	3.65
Day 7 through 12	3.72	3.24
Day 13 through 18	3.61	3.31
Day 19 through 24	3.58	3.22
Day 25 through 30	3.77	3.30

7-Day composite (Preserved)	$HgCl_2$	Milkeep	$HgCl_2$	Milkeep
Day 1 through 7	3.50	3.58	3.60	3.78
Day 8 through 14	3.55	3.63	3.23	3.34
Day 15 through 21	3.60	3.58	3.28	3.31
Day 22 through 28	3.68	3.73	3.20	3.20

15-Day composite (Preserved)	$HgCl_2$	Milkeep	$HgCl_2$	Milkeep
Day 1 through 15	3.53	3.64	3.48	3.48
Day 16 through 30	3.58	3.60	3.23	3.22

BUTTERFAT ANALYSIS FOR WINTER SAMPLING PERIOD
(February 20 through March 21)

Daily Test (Day No.)	Producer No. 1		Producer No. 2	
	Fat (%)	Milk (lb.)	Fat (%)	Milk (lb.)
1	3.88	2133	3.69	7777
2	3.83	2172	3.74	7786
3	3.97	2176	3.62	7667
4	3.90	2037	3.64	7557
5	3.99	2107	3.53	7649
6	3.90	2150	3.60	7584
7	3.85	2159	3.70	7649
8	3.95	2150	3.69	7758
9	4.10	2046	3.54	7804
10	3.97	2046	3.58	7767
11	3.92	2055	3.65	7822
12	3.95	2107	3.53	7941
13	4.14	2016	3.72	7758
14	4.03	2033	3.59	7694
15	4.04	2068	3.65	7603
16	3.98	2072	3.52	7584
17	4.09	2124	3.59	7685
18	4.17	2003	3.55	7557
19	4.13	1898	3.69	7630
20	4.17	2063	3.67	7484
21	4.09	2098	3.52	7511
22	4.08	2124	3.68	7557
23	3.98	2089	3.39	7283
24	3.99	2029	3.59	7392
25	4.19	2046	3.59	7392
26	4.10	2003	3.62	7273
27	4.15	2011	3.54	7301
28	4.23	2003	3.83	7466
29	4.44	1906	3.70	7447
30	4.30	1998	3.67	7273

	Fat (%)	Fat (%)
6-Day composite (Not preserved)		
Day 1 through 6	3.95	3.65
Day 7 through 12	4.10	3.64
Day 13 through 18	4.10	3.62
Day 19 through 24	4.07	3.61
Day 25 through 30	4.30	3.69

7-Day composite (Preserved)	$HgCl_2$	Milkeep	$HgCl_2$	Milkeep
Day 1 through 7	3.94	3.95	3.65	3.66
Day 8 through 14	4.04	4.08	3.67	3.60
Day 15 through 21	4.10	4.10	3.60	3.59
Day 22 through 28	4.13	4.12	3.61	3.65

15-Day composite (Preserved)	$HgCl_2$	Milkeep	$HgCl_2$	Milkeep
Day 1 through 15	3.98	3.92	3.65	3.60
Day 16 through 30	4.13	4.22	3.59	3.64

BUTTERFAT ANALYSIS FOR WINTER SAMPLING PERIOD
(February 20 through March 21)

Daily Test (Day No.)	Producer No. 3 Fat (%)	Producer No. 3 Milk (lb.)	Producer No. 4 Fat (%)	Producer No. 4 Milk (lb.)
1	4.60	1876	5.09	3811
2	4.87	2946	5.10	3773
3	4.90	2471	5.22	3811
4	4.90	2367	5.05	3825
5	4.64	2317	5.04	3773
6	4.71	2276	5.14	3759
7	4.65	2285	5.05	3697
8	4.85	2312	5.28	3650
9	4.92	2285	5.27	3678
10	4.84	2394	5.30	3664
11	4.69	2299	5.33	3707
12	4.89	2376	5.08	3667
13	5.02	2303	5.17	3692
14	4.85	2339	5.25	3678
15	4.83	2394	5.36	3669
16	5.02	2326	5.12	3778
17	4.95	2353	5.43	3556
18	4.98	2276	5.43	3598
19	4.85	2412	5.37	3584
20	5.04	2398	5.30	3541
21	4.63	2376	5.22	3631
22	5.08	2335	5.15	3499
23	5.13	1577	5.32	3565
24	4.92	3134	5.39	3508
25	4.84	2321	5.00	3565
26	4.80	2344	5.19	3608
27	4.87	2353	5.40	3660
28	4.92	2362	5.23	3603
29	4.73	2330	5.27	3476
30	4.72	2331	5.13	3419

	Producer No. 3 Fat (%)	Producer No. 4 Fat (%)
6-Day composite (Not preserved)		
Day 1 through 6	4.78	5.10
Day 7 through 12	4.89	5.23
Day 13 through 18	5.00	5.30
Day 19 through 24	4.99	5.31
Day 25 through 30	4.80	5.22

7-Day composite (Preserved)	Producer No. 3 $HgCl_2$	Producer No. 3 Milkeep	Producer No. 4 $HgCl_2$	Producer No. 4 Milkeep
Day 1 through 7	4.75[2]	4.75	5.00[2]	5.06
Day 8 through 14	4.87	4.78	5.22	5.27
Day 15 through 21	4.88	4.88	5.30	5.25
Day 22 through 28	4.89	4.90	5.19	5.18

15-Day composite (Preserved)	Producer No. 3 $HgCl_2$	Producer No. 3 Milkeep	Producer No. 4 $HgCl_2$	Producer No. 4 Milkeep
Day 1 through 15	4.78[2]	4.85	5.19[2]	5.18
Day 16 through 30	4.91	4.93	5.22	5.19

BUTTERFAT ANALYSIS FOR WINTER SAMPLING PERIOD
(February 20 through March 21)

Daily Test (Day No.)	Producer No. 5 Fat (%)	Producer No. 5 Milk (lb.)	Producer No. 6 Fat (%)	Producer No. 6 Milk (lb.)
1	3.41	2772	3.44	17102
2	3.13	2687	2.80	17458
3	3.58	2666	2.92	17382
4	3.53	2623	2.83	5787
5	3.43	2629	2.94	16807
6	3.44	2719	2.94	17309
7	3.42	2761	3.02	16594
8	3.54	2761	2.99	16984
9	3.50	2267	3.17	16743
10	3.43	3155	3.13	16984
11	3.36	2101	3.09	16829
12	3.44	3255	3.07	16786
13	3.56	1632	3.20	16682
14	3.47	3705	3.13	16442
15	3.37	1023	3.06	16641
16	3.44	4257	3.14	17360
17	3.42	2666	3.12	16848
18	3.47	2687	3.15	16542
19	3.41	2666	3.16	16850
20	3.50	2676	3.32	16829
21	3.44	2581	3.09	16764
22	3.53	2538	3.27	17063
23	3.52	2565	3.28	16424
24	3.42	2560	3.28	16653
25	3.60	2427	3.39	16713
26	3.54	2400	3.43	16287
27	3.50	2538	3.44	16940
28	3.77	2522	3.29	15937
29	3.53	2538	3.28	16935
30	3.57	2565	3.04	16711

	Fat (%)	Fat (%)
6-Day composite (Not preserved)		
Day 1 through 6	3.40	2.90
Day 7 through 12	3.51	3.07
Day 13 through 18	3.52	3.14
Day 19 through 24	3.50	3.29
Day 25 through 30	3.62	3.35

7-Day composite (Preserved)	$HgCl_2$	Milkeep	$HgCl_2$	Milkeep
Day 1 through 7	3.42	3.48	2.93	2.97
Day 8 through 14	3.52	3.47	3.16	3.12
Day 15 through 21	3.52	3.47	3.19	3.17
Day 22 through 28	3.61	3.59	3.31	3.29

15-Day composite (Preserved)	$HgCl_2$	Milkeep	$HgCl_2$	Milkeep
Day 1 through 15	3.43	3.40	3.02	2.95
Day 16 through 30	3.54	3.57	3.18	3.23

BUTTERFAT ANALYSIS FOR WINTER SAMPLING PERIOD
(February 20 through March 21)

Daily Test (Day No.)	Producer No. 7 Fat (%)	Producer No. 7 Milk (lb.)	Producer No. 8 Fat (%)	Producer No. 8 Milk (lb.)
1	3.23	2200	3.30	3800
2	3.23	2190	3.28	3800
3	3.30	2280	3.18	3741
4	3.20	2325	3.30	3613
5	3.10	2320	3.30	3465
6	3.24	2290	3.10	3298
7	3.28	2330	3.43	3710
8	3.24	2430	3.61	3784
9	3.32	2340	3.37	3848
10	3.28	2360	3.55	3623
11	3.13	2390	3.50	3643
12	3.10	2170	3.49	3593
13	3.19	3055	3.38	3928
14	3.24	1572	3.60	3684
15	3.14	3315	3.47	3415
16	3.28	2340	3.35	3731
17	3.63	2340	3.47	3669
18	3.37	2180	3.42	3553
19	3.33	2350	3.32	2605
20	3.40	2310	3.47	2672
21	3.27	2260	3.38	3207
22	3.47	2320	3.58	2441
23	3.49	2200	3.30	2431
24	3.35	2220	3.37	2421
25	3.26	2235	3.38	3335
26	3.43	2430	3.55	2436
27	3.52	2315	3.54	2268
28	3.40	2230	3.75	2373
29	3.29	2450	3.72	2185
30	3.64	2110	3.59	2339

	Fat (%)	Fat (%)
6-Day composite (Not preserved)		
Day 1 through 6	3.20	3.28
Day 7 through 12	3.23	3.44
Day 13 through 18	3.33	3.49
Day 19 through 24	3.24	3.38
Day 25 through 30	3.43	3.62

7-Day composite (Preserved)	$HgCl_2$	Milkeep	$HgCl_2$	Milkeep
Day 1 through 7	3.22	3.29	3.20	3.33
Day 8 through 14	3.26	3.29	3.47	3.40
Day 15 through 21	3.47	3.31	3.44	3.43
Day 22 through 28	3.78	3.39	3.50	3.48

15-Day composite (Preserved)	$HgCl_2$	Milkeep	$HgCl_2$	Milkeep
Day 1 through 15	3.23	3.20	3.38	3.33
Day 16 through 30	3.42	3.43	3.45	3.44

BUTTERFAT ANALYSIS FOR WINTER SAMPLING PERIOD
(February 20 through March 21)

Daily Test (Day No.)	Producer No. 9		Producer No. 10	
	Fat (%)	Milk (lb.)	Fat (%)	Milk (lb.)
1	3.73	2698	3.66	1429
2	3.83	2920	3.68	1630
3	3.84	2796	3.52	1630
4	3.80	2669	3.41	1507
5	3.65	2995	3.71	1691
6	3.72	2721	3.54	1755
7	3.64	2698	3.05	1790
8	3.88	2874	3.86	1846
9	3.77	2677	3.30	1755
10	3.87	2747	2.60	1828
11	3.73	2753	3.34	1794
12	3.67	2852	3.58	1777
13	3.76	2863	3.43	1811
14	3.73	2773	3.41	1828
15	3.61	2886	2.74	1876
16	3.77	2857	3.38	1833
17	3.70	2523	3.50	1738
18	3.73	3012	3.27	1846
19	3.69	3129	3.18	1794
20	3.77	3673	3.17	1914
21	3.74	2920	3.67	1656
22	3.72	2995	3.42	1708
23	3.77	2983	3.37	1764
24	3.75	2943	3.49	1730
25	3.71	2926	4.24	1282
26	3.61	2978	3.61	1463
27	3.92	2955	3.76	1489
28	4.00	2972	3.64	1616
29	3.89	2805	3.39	1656
30	3.79	2846	3.19	1581

	Fat (%)	Fat (%)
6-Day composite (Not preserved)		
Day 1 through 6	3.74	3.63
Day 7 through 12	3.72	3.49
Day 13 through 18	3.67	3.33
Day 19 through 24	3.70	3.37
Day 25 through 30	3.79	3.66

7-Day composite (Preserved)	$HgCl_2$	Milkeep	$HgCl_2$	Milkeep
Day 1 through 7	3.75	3.72	3.48	3.49
Day 8 through 14	3.79	3.77	3.33	3.36
Day 15 through 21	3.72	3.72	3.30	3.26
Day 22 through 28	3.74	3.75	3.61	3.64

15-Day composite (Preserved)	$HgCl_2$	Milkeep	$HgCl_2$	Milkeep
Day 1 through 15	3.77	3.77	3.41	3.36
Day 16 through 30	3.79	3.79	3.49	3.47

BUTTERFAT ANALYSIS FOR SPRING SAMPLING PERIOD
(April 14 through May 13)

Daily Test (Day No.)	Producer No. 1		Producer No. 2	
	Fat (%)	Milk (lb.)	Fat (%)	Milk (lb.)
1	4.09	2011	3.70	7063
2	3.92	2055	3.74	6971
3	3.98	2042	3.65	6917
4	3.82	2098	3.63	7063
5	4.12	1981	3.69	6724
6	4.05	1963	3.72	6843
7	3.75	1941	3.73	6149
8	3.97	2024	3.59	7566
9	4.12	1871	3.65	6715
10	3.98	1801	3.74	6743
11	3.99	1713	3.74	6606
12	3.92	1713	3.76	6724
13	4.52	1713	3.69	6624
14	4.24	1748	3.55	6734
15	2.62	1836	3.65	6697
16	3.92	1862	3.64	6680
17	3.89	1826	3.82	6477
18	4.09	1836	3.72	6642
19	3.89	1889	3.72	6532
20	3.97	1906	3.75	6441
21	4.02	1871	3.81	6487
22	4.04	1876	3.59	6587
23	4.00	1766	3.74	6715
24	3.82	1832	3.65	6606
25	4.03	1854	3.74	6459
26	3.85	1832	3.68	6349
27	4.01	1884	3.68	6569
28	3.98	1902	3.83	6258
29	3.92	1867	3.69	6606
30	4.00	1884	3.83	6589

	Fat (%)	Fat (%)
6-Day composite (Not preserved)		
Day 1 through 6	4.03	3.69
Day 7 through 12	3.92	3.66
Day 13 through 18	3.92	3.69
Day 19 through 24	3.94	3.66
Day 25 through 30	3.97	3.72

7-Day composite (Preserved)	$HgCl_2$	Milkeep	$HgCl_2$	Milkeep
Day 1 through 7	3.97	3.94	3.73	3.72
Day 8 through 14	4.08	4.03	3.64	3.66
Day 15 through 21	3.76	3.82	3.69	3.76
Day 22 through 28	3.98	3.92	3.64	3.72

15-Day composite (Preserved)	$HgCl_2$	Milkeep	$HgCl_2$	Milkeep
Day 1 through 15	3.91	3.95	3.67	3.69
Day 16 through 30	3.96	3.93	3.70	3.78

BUTTERFAT ANALYSIS FOR SPRING SAMPLING PERIOD
(April 14 through May 13)

Daily Test (Day No.)	Producer No. 3		Producer No. 4	
	Fat (%)	Milk (lb.)	Fat (%)	Milk (lb.)
1	4.64	2102	3.53	5026
2	4.79	2240	3.53	5218
3	4.63	2199	3.50	5059
4	4.66	2294	3.45	5172
5	4.72	2249	3.54	5210
6	4.73	2258	3.55	5126
7	4.60	2085	3.40	5187
8	4.49	2164	3.29	5249
9	4.66	2120	3.35	5141
10	4.78	2116	3.59	5026
11	4.65	2116	3.48	4912
12	4.75	2054	3.59	4823
13	4.72	2019	3.49	4926
14	4.60	1931	3.37	4897
15	4.94	1914	3.48	4808
16	4.57	1936	3.56	4860
17	4.40	1914	3.44	4763
18	4.52	1914	3.57	4808
19	4.85	1787	3.55	4808
20	4.88	1839	3.13	4748
21	4.87	1830	3.63	4660
22	4.62	1844	3.45	4912
23	4.57	1962	3.47	4815
24	4.00	1887	3.42	4837
25	4.69	1844	3.50	4741
26	4.84	1879	3.52	4737
27	4.75	1861	3.36	4741
28	4.40	1826	3.46	4800
29	4.49	1800	3.49	4719
30	4.74	1800	3.58	4704

	Fat (%)	Fat (%)
6-Day composite (Not preserved)		
Day 1 through 6	4.71	3.54
Day 7 through 12	4.58	3.43
Day 13 through 18	4.52	3.51
Day 19 through 24	4.53	3.42
Day 25 through 30	4.62	3.51

	$HgCl_2$	Milkeep	$HgCl_2$	Milkeep
7-Day composite (Preserved)				
Day 1 through 7	4.72	4.69	3.49	3.54
Day 8 through 14	4.55	4.58	3.39	3.44
Day 15 through 21	4.65	4.67	3.47	3.52
Day 22 through 28	4.56	4.45	3.47	3.38

	$HgCl_2$	Milkeep	$HgCl_2$	Milkeep
15-Day composite (Preserved)				
Day 1 through 15	4.60	4.68	3.49	3.47
Day 16 through 30	4.52	4.57	3.46	3.48

BUTTERFAT ANALYSIS FOR SPRING SAMPLING PERIOD
(April 14 through May 13)

Daily Test (Day No.)	Producer No. 5		Producer No. 6	
	Fat (%)	Milk (lb.)	Fat (%)	Milk (lb.)
1	5.00	3385	3.57	2348
2	5.19	3357	3.54	2422
3	5.13	3489	3.54	2453
4	5.02	3400	3.64	2443
5	5.12	3395	3.62	2390
6	5.02	3404	3.77	2453
7	4.98	3404	3.73	2311
8	4.68	3471	3.57	2411
9	5.06	3518	3.70	2306
10	4.95	3508	3.77	2285
11	4.77	3660	3.65	2206
12	5.16	3551	3.67	2253
13	5.12	3447	3.82	2169
14	4.99	3523	3.78	2190
15	5.09	3352	3.75	2248
16	4.92	3452	3.54	2327
17	4.74	3409	3.69	2295
18	4.88	3508	3.67	2306
19	4.63	3452	3.66	2275
20	4.71	3480	3.82	2227
21	5.02	3452	3.94	2264
22	4.83	3456	3.57	2243
23	4.73	3508	3.87	2133
24	4.57	3471	3.68	2290
25	4.67	3480	3.54	2306
26	4.86	3456	3.66	2411
27	4.76	3466	3.54	2327
28	4.78	3541	3.61	2327
29	4.85	3381	3.62	2269
30	4.89	3334	3.70	2306

	Fat (%)	Fat (%)
6-Day composite (Not preserved)		
Day 1 through 6	5.06	3.63
Day 7 through 12	4.88	3.66
Day 13 through 18	4.87	3.67
Day 19 through 24	4.70	3.77
Day 25 through 30	4.74	3.62

7-Day composite (Preserved)	$HgCl_2$	Milkeep	$HgCl_2$	Milkeep
Day 1 through 7	5.05	5.09	3.64	3.70
Day 8 through 14	4.90	4.85	3.67	3.68
Day 15 through 21	4.78	4.83	3.72	3.76
Day 22 through 28	4.69	4.68	3.60	3.62

15-Day composite (Preserved)	$HgCl_2$	Milkeep	$HgCl_2$	Milkeep
Day 1 through 15	4.92	4.96	3.66	3.66
Day 16 through 30	4.68	4.78	3.62	3.63

BUTTERFAT ANALYSIS FOR SPRING SAMPLING PERIOD
(April 14 through May 13)

Daily Test (Day No.)	Producer No. 7 Fat (%)	Producer No. 7 Milk (lb.)	Producer No. 8 Fat (%)	Producer No. 8 Milk (lb.)
1	3.37	11111	3.29	1861
2	3.39	11037	3.42	1760
3	3.17	11999	3.35	1827
4	3.33	11298	3.39	1678
5	3.47	9229	3.63	1764
6	3.35	9410	3.43	1784
7	2.98	3332	3.45	1871
8	3.19	9334	3.48	1900
9	3.22	15943	3.52	1908
10	3.08	15176	3.50	1929
11	3.31	15910	3.54	1803
12	3.11	15923	3.62	1856
13	3.17	15752	3.40	1004
14	3.42	13841	3.47	1755
15	3.13	15864	3.55	1861
16	3.29	14431	3.67	1779
17	3.12	15221	3.52	1793
18	2.98	15442	3.43	1900
19	2.73	15990	3.33	968
20	2.94	15738	3.59	1006
21	2.67	5421	3.65	1592
22	2.98	15302	3.57	1856
23	2.95	16142	3.38	1726
24	3.07	15766	3.48	912
25	3.08	15154	3.54	1707
26	2.90	15498	3.47	1755
27	2.82	15519	3.57	1750
28	2.64	5740	3.27	1716
29	2.88	16299	3.59	1688
30	3.07	15950	3.62	1554

	Fat (%)	Fat (%)
6-Day composite (Not preserved)		
Day 1 through 6	3.35	3.44
Day 7 through 12	3.08	3.50
Day 13 through 18	3.14	3.53
Day 19 through 24	3.34	3.51
Day 25 through 30	2.85	3.48

7-Day composite (Preserved)	$HgCl_2$	Milkeep	$HgCl_2$	Milkeep
Day 1 through 7	3.27	3.30	3.39	3.43
Day 8 through 14	3.22	3.12	3.49	3.53
Day 15 through 21	2.98	2.99	3.50	3.55
Day 22 through 28	2.92	2.92	3.46	3.45

15-Day composite (Preserved)	$HgCl_2$	Milkeep	$HgCl_2$	Milkeep
Day 1 through 15	3.19	3.21	3.43	3.44
Day 16 through 30	2.93	2.93	3.50	3.48

BUTTERFAT ANALYSIS FOR SPRING SAMPLING PERIOD
(April 14 through May 13)

Daily Test (Day No.)	Producer No. 9 Fat (%)	Producer No. 9 Milk (lb.)	Producer No. 10 Fat (%)	Producer No. 10 Milk (lb.)
1	3.87	2741	2.50	1638
2	3.89	2567	2.49	1616
3	3.84	2677	3.71	1185
4	3.80	2660	3.99	1261
5	3.82	2674	3.82	1202
6	3.81	2706	4.07	1134
7	3.67	2637	3.57	1269
8	3.68	2730	3.40	1261
9	3.82	2589	3.72	1294
10	3.86	2637	4.00	1231
11	3.87	2627	3.87	1197
12	3.83	2618	3.77	1062
13	3.74	2657	3.73	1412
14	3.69	2764	3.87	1069
15	3.73	2735	3.83	1244
16	3.83	2558	3.63	1235
17	3.78	2648	3.88	1311
18	3.82	2510	3.78	879
19	3.80	2274	3.74	1286
20	3.79	2425	3.74	1328
21	3.72	2331	3.37	1385
22	3.74	2402	3.69	1385
23	3.83	2288	3.95	1328
24	3.83	2217	3.23	1379
25	3.70	2200	3.97	1429
26	3.91	2264	3.57	1417
27	3.97	2244	3.95	1345
28	3.89	2288	3.64	1580
29	3.82	2247	3.43	1580
30	3.78	2412	3.62	1446

	Fat (%)	Fat (%)
6-Day composite (Not preserved)		
Day 1 through 6	3.86	3.43
Day 7 through 12	3.75	3.66
Day 13 through 18	3.75	3.79
Day 19 through 24	3.78	3.51
Day 25 through 30	3.82	3.69

7-Day composite (Preserved)	$HgCl_2$	Milkeep	$HgCl_2$	Milkeep
Day 1 through 7	3.82	3.81	3.47	3.47
Day 8 through 14	3.76	3.77	3.72	3.70
Day 15 through 21	3.79	3.80	3.64	3.65
Day 22 through 28	3.84	3.76	3.75	3.71

15-Day composite (Preserved)	$HgCl_2$	Milkeep	$HgCl_2$	Milkeep
Day 1 through 15	3.72	3.74	3.58	3.60
Day 16 through 30	3.76	3.79	3.59	3.62

BUTTERFAT ANALYSIS FOR SUMMER SAMPLING PERIOD
(June 13 through July 12)

Daily Test (Day No.)	Producer No. 1 Fat (%)	Producer No. 1 Milk (lb.)	Producer No. 2 Fat (%)	Producer No. 2 Milk (lb.)
1	4.10	2167	3.30	1885
2	4.10	2129	3.30	1664
3	3.95	2209	3.58	1857
4	4.08	2153	3.48	1772
5	4.10	2242	3.20	1815
6	4.10	2195	3.20	1750
7	4.20	2143	3.50	1650
8	3.95	2143	3.38	1825
9	3.85	2148	3.25	1764
10	4.08	2143	3.20	1750
11	4.05	2111	3.43	1693
12	4.10	2045	3.40	1747
13	4.00	2134	3.23	1764
14	3.95	2064	3.05	1506
15	3.95	1999	3.30	1485
16	4.18	1910	3.50	1618
17	4.08	1956	3.10	1689
18	4.03	1942	3.30	1693
19	4.10	1934	3.30	1603
20	4.07	1971	3.20	1560
21	4.07	2027	3.48	1589
22	4.03	1933	3.20	1528
23	4.08	1989	3.20	1553
24	3.98	1947	3.30	1428
25	4.03	1895	3.23	2065
26	4.25	2073	3.31	1696
27	4.09	1947	3.53	2139
28	3.98	1931	3.20	1489
29	3.98	1933	3.20	1460
30	4.05	1961	3.48	1648

	Producer No. 1 Fat (%)	Producer No. 2 Fat (%)
6-Day composite (Not preserved)		
Day 1 through 6	3.95	3.25
Day 7 through 12	4.00	3.40
Day 13 through 18	4.03	3.23
Day 19 through 24	4.05	3.23
Day 25 through 30	3.98	3.48

7-Day composite (Preserved)	Producer No. 1 $HgCl_2$	Producer No. 1 Milkeep	Producer No. 2 $HgCl_2$	Producer No. 2 Milkeep
Day 1 through 7	3.95	4.20	3.20	3.35
Day 8 through 14	3.95	3.98	3.05	3.28
Day 15 through 21	4.00	3.90	3.30	3.18
Day 22 through 28	4.10	4.05	3.33	3.33

15-Day composite (Preserved)	Producer No. 1 $HgCl_2$	Producer No. 1 Milkeep	Producer No. 2 $HgCl_2$	Producer No. 2 Milkeep
Day 1 through 15	4.00	3.98	3.28	3.38
Day 16 through 30	4.05	4.03	3.38	3.43

BUTTERFAT ANALYSIS FOR SUMMER SAMPLING PERIOD
(June 13 through July 12)

Daily Test (Day No.)	Producer No. 3 Fat (%)	Producer No. 3 Milk (lb.)	Producer No. 4 Fat (%)	Producer No. 4 Milk (lb.)
1	4.00	2016	3.50	4864
2	3.90	2098	3.68	4692
3	4.00	2016	3.55	4795
4	4.00	1978	3.63	4838
5	4.15	1815	3.58	4795
6	3.93	2530	3.62	4829
7	4.00	2107	3.68	2726
8	3.90	2094	3.60	4864
9	3.88	2133	3.55	4795
10	3.90	2168	3.30	4795
11	4.00	2207	3.65	4666
12	3.78	2129	3.70	4563
13	3.93	2237	3.53	4511
14	3.78	2163	3.23	4614
15	3.85	2168	3.58	4416
16	4.00	2046	3.70	4244
17	4.05	2089	3.05	4296
18	4.03	2024	3.55	4244
19	4.38	2029	3.63	4348
20	4.03	1950	3.22	4313
21	3.93	2007	3.58	4287
22	3.93	1998	3.58	4296
23	4.00	1933	3.58	6059
24	3.95	1933	3.63	1968
25	3.96	1871	3.60	3756
26	3.85	1924	3.78	3806
27	3.83	1911	3.55	3806
28	3.88	1880	3.55	3949
29	3.70	1924	3.55	3940
30	3.80	1941	3.50	3890

	Producer No. 3 Fat (%)	Producer No. 4 Fat (%)
6-Day composite (Not preserved)		
Day 1 through 6	3.85	3.65
Day 7 through 12	3.88	3.55
Day 13 through 18	3.85	3.48
Day 19 through 24	3.95	3.60
Day 25 through 30	3.78	3.55

7-Day composite (Preserved)	Producer No. 3 $HgCl_2$	Producer No. 3 Milkeep	Producer No. 4 $HgCl_2$	Producer No. 4 Milkeep
Day 1 through 7	3.88[2]	4.10	3.43[2]	3.75
Day 8 through 14	3.78	3.93	3.23	3.48
Day 15 through 21	4.00	3.95	3.60	3.50
Day 22 through 28	3.80	3.80	3.58	3.58

15-Day composite (Preserved)	Producer No. 3 $HgCl_2$	Producer No. 3 Milkeep	Producer No. 4 $HgCl_2$	Producer No. 4 Milkeep
Day 1 through 15	3.90[2]	3.93	3.55[2]	3.55
Day 16 through 30	3.90	3.90	3.58	3.58

BUTTERFAT ANALYSIS FOR SUMMER SAMPLING PERIOD
(June 13 through July 12)

Daily Test (Day No.)	Producer No. 5		Producer No. 6	
	Fat (%)	Milk (lb.)	Fat (%)	Milk (lb.)
1	4.80	2362	4.80	3423
2	4.70	1716	4.68	3404
3	4.00	2489	4.53	3357
4	4.80	944	4.95	3428
5	4.45	3241	4.68	3338
6	4.58	2002	4.78	3404
7	4.75	1984	4.85	3937
8	4.55	1849	4.80	3414
9	4.55	1909	4.60	3357
10	4.58	1975	4.85	3346
11	4.60	1901	4.90	3437
12	4.55	1993	4.78	3452
13	4.70	1984	4.50	3419
14	4.35	1988	4.50	3348
15	4.53	2037	4.83	3376
16	4.40	2023	4.78	3338
17	4.95	1958	4.73	3348
18	4.25	2059	4.48	3352
19	4.20	1966	4.66	3135
20	4.65	2050	4.58	3182
21	4.50	2041	4.60	3220
22	4.60	2076	4.35	3215
23	4.48	2070	4.70	3211
24	4.53	2120	4.50	3258
25	4.54	1985	4.52	2744
26	4.60	1985	4.70	3820
27	4.38	2045	4.63	3348
28	4.40	1931	4.63	3338
29	4.33	2085	4.58	3282
30	4.20	1958	4.80	3265

	Fat (%)	Fat (%)
6-Day composite (Not preserved)		
Day 1 through 6	4.63	4.73
Day 7 through 12	4.50	4.28
Day 13 through 18	4.43	4.38
Day 19 through 24	4.43	4.48
Day 25 through 30	4.20	4.63

7-Day composite (Preserved)	$HgCl_2$	Milkeep	$HgCl_2$	Milkeep
Day 1 through 7	4.68	4.65	4.68	4.85
Day 8 through 14	4.35	4.55	4.50	4.50
Day 15 through 21	4.53	4.48	4.50	4.50
Day 22 through 28	4.23	4.25	4.53	4.58

15-Day composite (Preserved)	$HgCl_2$	Milkeep	$HgCl_2$	Milkeep
Day 1 through 15	4.60	4.55	4.60	4.62
Day 16 through 30	4.40	4.40	4.60	4.65

BUTTERFAT ANALYSIS FOR SUMMER SAMPLING PERIOD
(June 13 through July 12)

Daily Test (Day No.)	Producer No. 7 Fat (%)	Producer No. 7 Milk (lb.)	Producer No. 8 Fat (%)	Producer No. 8 Milk (lb.)
1	3.60	1855	4.10	4076
2	3.58	1840	4.30	4025
3	3.38	1998	3.98	4205
4	3.88	1761	4.15	3999
5	3.68	1924	4.10	4033
6	3.50	1840	4.15	4055
7	3.60	1916	4.38	4059
8	3.63	1819	5.50	4059
9	3.75	1761	4.05	4086
10	3.55	1761	4.28	4042
11	3.50	1813	4.15	4008
12	3.58	1834	4.20	3939
13	3.55	1924	4.15	3990
14	3.40	1913	4.25	4016
15	3.45	1945	4.40	3990
16	3.58	1850	4.30	3904
17	3.63	1850	4.28	3939
18	3.43	1908	4.33	4042
19	3.55	1869	4.30	4000
20	3.54	1887	4.10	2912
21	3.52	1998	4.10	2904
22	3.53	1995	4.05	2920
23	3.50	1982	4.15	4016
24	3.53	1903	4.18	4042
25	3.55	1987	4.13	4008
26	3.60	1982	4.10	2922
27	3.50	2020	4.08	4171
28	3.55	2063	4.15	3100
29	3.45	2009	4.08	4266
30	3.50	2031	4.05	4300

	Fat (%)	Fat (%)
6-Day composite (Not preserved)		
Day 1 through 6	3.60	4.00
Day 7 through 12	3.58	4.45
Day 13 through 18	3.45	4.25
Day 19 through 24	3.54	4.13
Day 25 through 30	3.53	4.10

7-Day composite (Preserved)	$HgCl_2$	Milkeep	$HgCl_2$	Milkeep
Day 1 through 7	3.68	3.65	4.15	4.18
Day 8 through 14	3.40	3.60	4.25	4.43
Day 15 through 21	3.50	3.48	4.30	4.10
Day 22 through 28	3.50	3.55	4.15	4.05

15-Day composite (Preserved)	$HgCl_2$	Milkeep	$HgCl_2$	Milkeep
Day 1 through 15	3.58	3.68	4.28	4.28
Day 16 through 30	3.50	3.48	4.10	4.15

BUTTERFAT ANALYSIS FOR SUMMER SAMPLING PERIOD
(June 13 through July 12)

Daily Test (Day No.)	Producer No. 9 Fat (%)	Producer No. 9 Milk (lb.)	Producer No. 10 Fat (%)	Producer No. 10 Milk (lb.)
1	3.40	4708	3.60	4473
2	3.40	4791	3.50	4614
3	3.30	4901	3.35	4614
4	3.35	4906	3.50	4703
5	3.30	4939	3.20	4614
6	3.43	4780	3.38	4762
7	3.45	4807	3.48	4703
8	3.58	4179	3.38	4251
9	3.35	4829	3.35	4629
10	3.40	4730	3.40	4584
11	3.43	4829	3.48	4681
12	3.45	4708	3.60	4362
13	3.45	4741	3.53	4466
14	3.35	4581	3.28	4606
15	3.50	4491	3.55	4532
16	3.58	4458	3.60	4354
17	3.45	4284	3.50	4354
18	3.47	4179	3.45	4251
19	3.50	4307	3.52	4320
20	3.47	4253	3.49	4354
21	3.44	4339	3.57	4073
22	3.43	4376	3.56	4317
23	3.40	4277	3.60	4139
24	3.48	4863	3.55	3875
25	3.42	3452	3.53	4073
26	3.30	4210	3.58	4095
27	3.47	4118	3.52	4132
28	3.50	3983	3.48	3917
29	3.50	4265	3.49	3969
30	3.40	4032	3.60	4110

	Fat (%)	Fat (%)
6-Day composite (Not preserved)		
Day 1 through 6	3.35	3.38
Day 7 through 12	3.43	3.50
Day 13 through 18	3.43	3.53
Day 19 through 24	3.45	3.60
Day 25 through 30	3.48	3.48

7-Day composite (Preserved)	$HgCl_2$	Milkeep	$HgCl_2$	Milkeep
Day 1 through 7	3.40	3.50	3.43	3.58
Day 8 through 14	3.40	3.35	3.28	3.40
Day 15 through 21	3.43	3.46	3.50	3.50
Day 22 through 28	3.48	3.53	3.60	3.58

15-Day composite (Preserved)	$HgCl_2$	Milkeep	$HgCl_2$	Milkeep
Day 1 through 16	3.35	3.40	3.40	3.45
Day 16 through 30	3.45	3.50	3.50	3.60