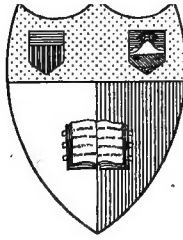


**DAIRY LABORATORY  
MANUAL AND NOTE BOOK  
ERNEST L. ANTHONY, B.S.A.**



New York  
State College of Agriculture  
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# DAIRY LABORATORY MANUAL AND NOTE BOOK

COMPILED BY

ERNEST L. ANTHONY, B.S.A.

INSTRUCTOR IN DAIRY HUSBANDRY, THE PENNSYLVANIA STATE COLLEGE

*15 ILLUSTRATIONS IN THE TEXT*



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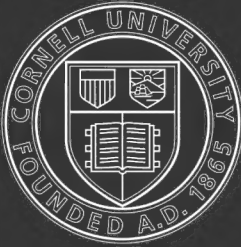
## PREFACE

The following exercises have been arranged especially for general courses in the Elements of Dairying. A number of these exercises have been used in separate form and have been brought together for courses of this nature. They are designed to cover the use of the Babcock Tester, Lactometer, and special work with Farm Separators and Churns. They have all been used by the writer in class work, a number of them were recommended by the Committee on the Courses of Study of the Official Dairy Instructors' Association.

These exercises are designed to be used with courses having two or more hours' laboratory practice each week, and should familiarize the student sufficiently with the general practice so that he may be able to handle the more advanced courses in testing and creamery work. The exercises are on separate pages so that the book may be used as a note book, and all answers and notations can be made while the student is in the laboratory.

ERNEST L. ANTHONY

Pennsylvania State College,  
January 1, 1914



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## DEFINITIONS

*Definition for Milk.*—Normal milk is a liquid secreted by all healthy females of the mammalian group, for feeding their offspring.

*Definition for Specific Gravity.*—The specific gravity of a substance is the relation between the weight of that substance and the weight of an equal volume of distilled water. Water is always considered as one, or the unit, with which liquids and solids of the same temperature are compared. Examples:

1 gallon of water weighs 8.3 lbs.	Specific Gravity	1.
1 gallon of milk weighs 8.6 lbs.	“ “	1.032
1 gallon of butterfat weighs 7.7 lbs.	“ “	.93

*Definition of Centrifugal Force.*—Centrifugal force is the outward pull or pressure brought on a wheel or object when rotating and being whirled from the centre. The centrifugal force is increased (*a*) directly in proportion to the decrease in the diameter (the velocity remaining the same), and (*b*) directly with the square of the velocity (diameter being constant).

# DAIRY LABORATORY MANUAL AND NOTE BOOK

## DAIRY RULES.

1. Rule for determining the number of pounds of butterfat in a given amount of cream or milk when the percentage of fat is given.

Multiply the percentage of butterfat by the pounds of milk and divide by 100 (*i.e.*, point off two places).

2. Rule for determining the percentage of casein in milk when the percentage of fat is known. (Van Slyke.)

Subtract 3 from the percentage of fat in milk, multiply the remainder by .4 and add 2.1 to the result.

Milk with 4.8 per cent fat has 2.82 per cent casein  $[(4.8-3) \times .4 + 2.1 = 2.82]$ .

3. Rule for determining the price per pound received for butterfat in cream when the percentage of fat and the price per gallon are given.

Multiply the pounds of cream in a gallon by the percentage of fat given (point off two places). This will give the pounds of fat one gallon of cream contains. Divide the number representing the price per gallon of cream by the number of pounds of butterfat, the quotient will equal the price per pound of butterfat.

4. Rule for determining the price of a gallon of cream when it is being paid for on the butterfat basis.

Multiply the percentage of fat in the cream by the pounds of cream in a gallon (point off two places). This will give the number of pounds of fat in a gallon. Multiply this by the price per pound paid for fat.

5. Rules for finding the percentage of solids not fat.

*Rule A.*—(A rough practical rule.) The (Quevenne) lactometer reading plus the percentage of fat divided by 4 equals the solids not fat.

*Rule B.*—(Accurate rule, recommended for accurate work.)

One fourth of the (Quevenne) lactometer reading plus .2 times the fat equals the solids not fat.

If the lactometer reading is 31 and the fat is 3.8 per cent the solids not fat equal 8.51 per cent.  $(31 \div 4 + .2 \times 3.8 = 8.51)$ .

6. Rule for finding the percentage of acid by Mann's acid test.

Multiply the number of cc. of alkali solution used, by .009 and divide the product by the number of cc. of the sample tested, the quotient when multiplied by 100 will give the percentage.

7. Rule for finding the percentage of overrun in butter.

Subtract from the butter made, the pounds of fat in the cream used. Divide the result by the butterfat in the cream and multiply by 100. This equals the percentage of actual overrun.

If 450 pounds of butter is made from cream containing 395 pounds of fat, the pounds of overrun is  $(450 - 395 = 55)$ . The percentage is  $[(55 \div 395) \times 100 = ]$  13.9 per cent.

8. To find the correct specific gravity of a sample when the temperature is other than 60° F.

Add one-tenth of a per cent to the reading for each degree above 60°, and subtract one-tenth for each degree below 60°.

#### RULES FOR STANDARDIZATION.

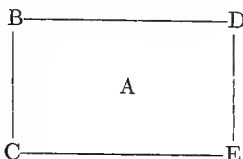
In many cases it is necessary to change the per cent fat in milk or cream to some other known per cent fat. This is called standardizing. In much standardization work it is necessary to find the relative amount of two different milks or creams of different percentages of fat to make a certain amount of standardized milk or cream of a known per cent of fat. This is found by:

9. Subtracting the difference between the fat desired in the standardized milk, and the milk of the lower fat content; and by subtracting the difference between the percentage of fat in the milk of the lower fat content and the percentage of fat in the milk or cream of the higher fat content. The first result when divided into the last will give the percentage of the amount wanted which must be used of the milk or cream of the higher fat content. This amount taken from the total amount wanted will give the amount of the lower milk or cream to be used, as:

100 pounds of 3.5 per cent milk is desired. It is to be made from milk testing 3 per cent and milk testing 5 per cent.

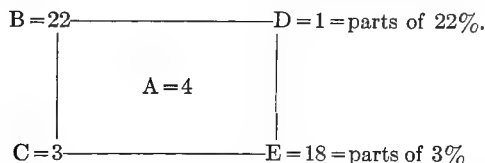
$3.5 - 3 = .5$ ;  $5 - 3 = 2$ .  $.5 \div 2 = .25$ . 25 per cent, or  $1/4$  of the mixture, must be of the 5 per cent milk and 75 per cent of it must be of the 3 per cent milk.  $100 - 25 = 75$  pounds of the 3 per cent milk to be used; 25 pounds of the 5 per cent milk to be used.

10. The parallelogram method of standardization was devised by Professor R. A. Pearson, and is illustrated as follows:



In the rectangle let A always represent the percentage of fat wanted in the standardized milk. Let B represent the per cent of fat in the milk or cream of the higher fat content. Let C represent the per cent of fat in the milk or cream of the lower fat content. The proportion D is secured by subtracting C from A; and the proportion E is secured by subtracting A from B. D represents the proportion of B to be taken, and E represents the proportion of C to be taken.

These proportions give the parts of the milk or cream of the different percentages of fat which when added together in these proportions will give the desired percentage of fat in the standardized milk or cream. These proportions when added together and divided into the amount desired will give in pounds the value of each part. This multiplied by the number of parts found in each proportion will give the number of pounds of each to use. To illustrate:



95 pounds of 4 per cent milk is desired. It is to be made from milk testing 3 per cent and cream testing 22 per cent.

$18 + 1 = 19$  parts.  $95 \div 19 = 5$ . 5 represents the value in pounds of one part or proportion. Then  $5 \times 18 = 90$  pounds of 3 per cent to use.  $5 \times 1 = 5$  pounds of 22 per cent to use.

11. Where milk is to be reduced by adding skimmilk.

By dividing the percentage of fat in the milk wanted by the percentage of fat in the milk on hand will give the percentage or the amount of the milk to be used, and the rest must be added as skimmilk. Thus:

300 pounds of 5 per cent milk is to be mixed with skimmilk to form 4 per cent milk. ( $4 \div 5 = .80$ .) Then 300 pounds represents 80 per cent of the

mixture wanted, and the rest, or 20 per cent, equals the amount that must be added as skimmilk. 20 per cent of 300 = 75.  $300 + 75 = 375$  pounds of the standardized milk.

12. Where milk is to be raised to a higher per cent of fat by adding milk or cream of a still higher fat content.

Subtract the percentage of fat in the milk on hand which contains the lower fat content from the percentage desired in the standardized product. Take the difference between the percentage of fat in the milk or cream of the higher fat content and the desired percentage of fat in the standardized milk. Divide the first result by the second, and the result represents the part of the milk or cream of the higher per cent fat to be used. Multiply this result by the pounds of milk which contains the lower per cent fat, and this will give the amount of the richer milk to add. This, added to the amount of the milk with the lower fat content, will give the total amount standardized. Thus:

300 pounds of 3 per cent milk is to be made to test 3.5 per cent by adding 5 per cent milk. ( $3.5 \text{ per cent} - 3 \text{ per cent} = .5$ ; and  $5 \text{ per cent} - 3.5 \text{ per cent} = 1.5$ );  $.5 \div 1.5 = .33 \frac{1}{3}$ ;  $300 \times .33 \frac{1}{3} = 100$ . Use 100 pounds of 5 per cent milk with 300 pounds of 3 per cent milk, or a total of 400 pounds of 3.5 per cent standardized milk.

13. By dividing the per cent of fat in the standardized milk into the percentage of fat in the milk on hand and multiplying the result by the number of pounds of the milk on hand will give the number of pounds of the standardized milk which can be made from the milk on hand. If the quantity of the standardized milk is less than the amount on hand, then the difference must be taken out as skimmilk; if greater, it must be added as skimmilk. To illustrate:

300 pounds of 3.5 milk will make how many pounds of 4 per cent milk?  $3.5 \div 4 = .875$ ;  $.875 \times 300 = 262.5$  pounds of 4 per cent milk which can be secured, or  $300 - 262.5 = 37.5$  pounds of skimmilk to be removed.

14. When it is desired to determine the number of pounds of standardized milk a quantity of milk of a lesser per cent of fat will make.

Find the pounds of butterfat in the quantity of milk by multiplying the pounds of milk by the per cent (point fat off two places). Then by dividing this result by the percentage fat desired in the standardized milk and multiplying the result by 100 will give the number of pounds of standardized milk. Thus:

300 pounds of 3.5 milk contains ( $300 \times 3.5 = 10.5$ ) pounds fat. This would make ( $10.5 \div 4 \times 100 = 262.5$ ) pounds of milk testing 4 per cent.



Grade .....

Date .....

EXERCISE 1.

(15)

OBJECT.—To determine the physical differences between milk, cream and skimmilk.

APPARATUS.—Samples of milk, cream, and skimmilk, beakers, and microscopes.

NOTE TO INSTRUCTORS.—Slides of skimmilk, whole milk, and cream should be prepared previous to the class period, and adjusted in the microscope, as students in first taking up this work will not be familiar enough with the different apparatus to properly make up the slides.

- Step 1. Study the differences found in the appearance of the sample of the milk, cream, and skimmilk.
- Step 2. Study the field under the first microscope. Note the size, the shape, and the color of the fat globules.
- Step 3. Study the field under the second microscope. Note the number of fat globules compared with those in the field of the first microscope. Note their size and shape.
- Step 4. Study the field under the third microscope. Note the size and shape of the globules compared with those of the second microscope.
- Step 5. Draw one of the fields in the space of this page. Write up the steps at the bottom of this page, explaining all the differences noted in the three fields.

(16)

## EXERCISE 2.

OBJECT.—To determine the accuracy of the calibration of the glassware used for the Babcock test.

APPARATUS.—Set of bottles used for test, and burette. Sheet of filter paper.

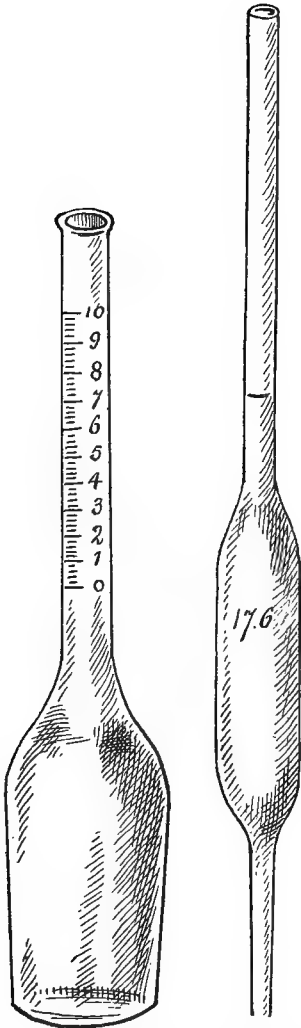
Step 1. *Burette Method.*—Fill the bottle to be tested to the zero mark with water. By means of a strip of filter paper remove any water adhering inside the neck above the zero mark. Measure into the bottle, from an accurate burette, 1 cc. of water. If the bottle is correct this should bring the water to the 5 per cent mark. Another cc. from the burette should bring the water to the 10 per cent mark.

In case of the cream bottles, if 9 gram bottles are used, 1 cc. of water will fill the bottle to the 10 per cent mark, or 5 cc. to 50 per cent mark.

Test all bottles by this method, recording all data.

Step 2. *Accuracy of the Pipette.*—Allow 17.6 cc. of water from the burette to run into a pipette, the bottom of which is closed with the finger. If correct the water will be at the 17.6 cc. mark.

Any glassware showing more than .2 per cent error should not be used.



Whole milk bottle.

17.6 cc. pipette  
for milk.

EXERCISE 2 (CONTINUED)

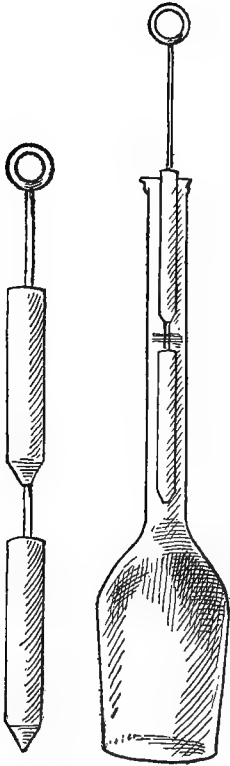
(17)

*Data.*

Style of bottle	Bottle No.	Water by measure	Variation 5% mark	Total variation
Pipette				

(18)

## EXERCISE 3.



Trowbridge plug and  
method of using.

**OBJECT.**—To determine the accuracy of the calibration of the glassware used for the Babcock test by the Trowbridge plug method; also a method for washing up glassware.

**APPARATUS.**—Set of bottles used for the test, set of Trowbridge (or Nefus) plugs, sheet filter paper.

**Part 1. Trowbridge Method.**—Fill the bottle to the zero. With filter paper, dry the neck inside above the zero mark. Insert the plug until the water rises half way between the two sections. In a correct bottle the surface will be at 5 per cent. Lower the plug until the upper portion is  $\frac{1}{8}$  inch below the surface. The water should be at the 10 per cent mark. Record all data.

**Part 2.** All glassware should be thoroughly washed and be always left clean at the end of each laboratory period. Take a dish pan of warm water and put in it about two tablespoonfuls of some good washing powder. Put the bottles in the suds thus formed and let the bottles fill about half full of the hot solution. Then take bottles in each hand and shake well. After they have been washed as well as possible in this manner use a small bottle brush to clean out the necks of the bottles. Take them out of the water and rinse with clean warm water. Use this same method for all other glassware. This method if carefully used will always keep all glassware in the best possible condition. Care and attention should be given to always have all apparatus in the best possible shape.



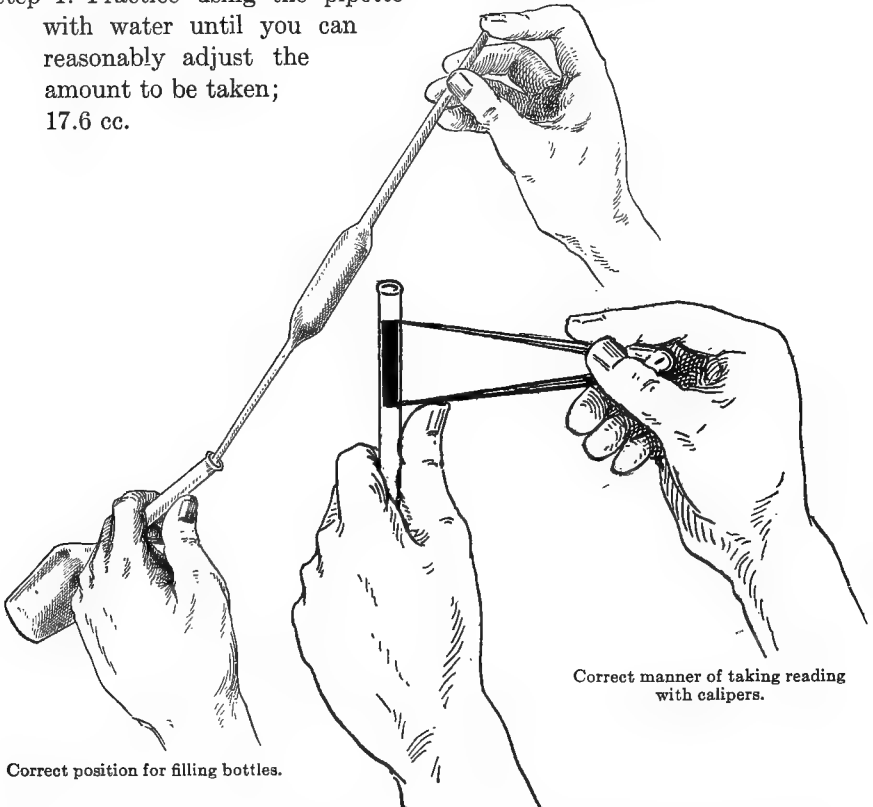
(20)

## EXERCISE 4.

OBJECT.—To make a test of milk for butterfat, by the Babcock method.

APPARATUS.—Two whole milk bottles; a 17.5 cc. pipette; acid measure; acid; sample of whole milk; two sample bottles; hot water bath.

Step 1. Practice using the pipette with water until you can reasonably adjust the amount to be taken; 17.6 cc.



Step 2. Always have milk between 60° and 70° F. before drawing sample with pipette.

Step 3. Mix the milk thoroughly by pouring from one vessel into another before drawing sample. Always pour down the side of the vessel.

Step 4. Put 17.6 cc. of milk into each of two whole milk bottles. Allow the milk to run down along the neck by holding the pipette and bottle at an angle of about 60°. (Letter one sample "A" and the other "B".)

Step 5. To each bottle add 17.5 cc. of sulphuric acid (1.82 to 1.83 s. g.), using an acid measure. Turn bottle slowly as acid is added, allowing acid to run down the sides of the neck.

Step 6. Agitate each bottle until the curd is all dissolved, by giving it a rotary motion as soon as acid is added.

Step 7. Put them into a centrifugal machine, whirl five minutes, fill to the neck with water about 130° F., whirl two minutes, fill to about the 9 per cent mark, whirl one minute, and read.

NOTE.—Read the whole milk test from the top of the upper meniscus to the bottom of the lower meniscus.

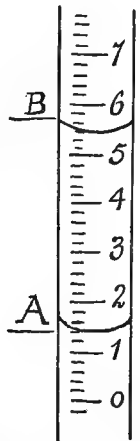
*Report.*

Bottle No.....	A	B
% fat.....		

1. Below give reasons for having the milk at 60° to 70°.
2. Why is the milk poured from one vessel to another before sampling?
3. Explain the action of acid in the test.
4. Why should each sample of milk be tested in duplicate?
5. What is the color of the fat column?



Eight-bottle hand tester. Farm size.



Correct method of taking reading on whole milk bottles. From the extremelower meniscus to the top of the upper meniscus.

Grade.....

Date.....

(22)

EXERCISE 5.

OBJECT.—To test whole milk for fat content by Babcock method.

Repeat Exercise 4. Test as many samples of milk as possible during the laboratory period.

Report.

Bottle No. ....							
% fat. $\left\{ \begin{array}{l} A \\ B \end{array} \right.$ .....							

1. Try to account for any difference in tests between samples "A" and "B" in each case.
2. What would be the pounds of butterfat given by a cow giving 8000 pounds of milk per year with the fat test of your first sample?
3. What would be its total value at 38 cents a pound?
4. Why is 17.6 cc. of milk used for the test?
5. Why are the bottles set in water at 130° F. before reading?



## EXERCISE 6.

(23)

OBJECT.—To test cream for fat content by Babcock method.

APPARATUS.—Two cream bottles; acid measure; acid; 17.6 cc. pipette; sample of cream; two mixing beakers; scales; hot water bath.

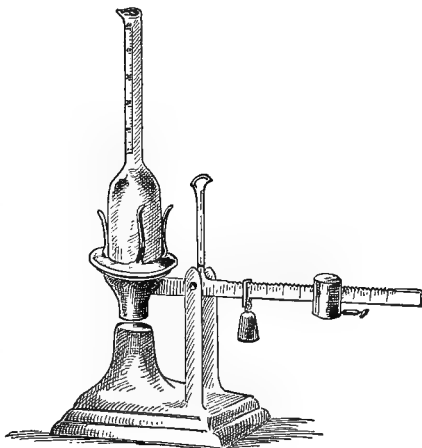
Step 1. Mix sample of cream thoroughly by pouring from one beaker to another, care being taken not to churn it.

Step 2. Balance cream bottle A on scales and weigh into it 9 grams of cream. Duplicate in bottle B.

Step 3. Measure out about 9 cc. of water at 60° to 70° for each cream bottle. Add to each bottle.

Step 4. Measure out 17.6 cc. of acid for each bottle and complete test as for whole milk.

Note.—Read cream test from bottom of fat column to bottom of top meniscus.



Small laboratory cream scales.

*Report.*

Bottle No.....				
% fat { $\frac{A}{B}$ .....				

At the bottom of the page explain—

1. Why cream columns are different from milk.
2. Why cream is weighed out instead of being measured out, as is done with milk.
3. Why 9 cc. of water is added before the acid.

Grade .....

Date .....

(24)

### EXERCISE 7.

OBJECT.—To test cream for fat content by Babcock method.

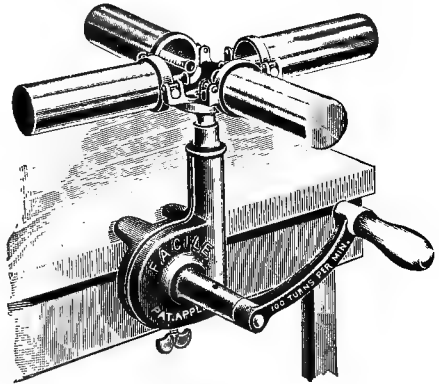
Repeat Exercise 6. Run as many samples as possible, during laboratory period.

*Report.*

Bottle No. ....							
% fat $\left\{ \begin{array}{l} A \\ B \end{array} \right.$ .....							

At the bottom of the page explain—

1. How many pounds of fat in 1875 pounds of cream with a test of the first sample?
2. What was the color of the fat in the column? Any variation?
3. What would happen if the acid were added before the water?



Small four-bottle tester.

Grade .....

Date.....

EXERCISE 8. (25)

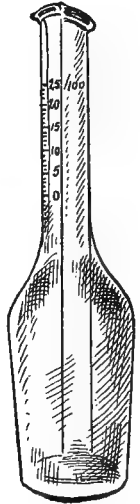
OBJECT.—To determine the percentage of fat in skimmilk and whey.

APPARATUS.—Samples of each, skimmilk and whey; skimmilk bottles; pipette; acid measure; mixing beakers; acid; hot water bath.

Step 1. Measure out 17.6 cc. first of skimmilk in each of two skimmilk bottles.

Proceed as for whole milk test except use a little in excess of 17.5 cc. of acid.

Step 2. Repeat test in the same manner using whey instead of skimmilk.



Skimmilk Bottle.

Report.

Skimmilk bottle No...								
% of fat $\left\{ \begin{array}{l} A \\ B \end{array} \right.$ .....								
Whey bottle No.....								
% of fat $\left\{ \begin{array}{l} A \\ B \end{array} \right.$ .....								

At the bottom of the page explain—

1. Why is a different bottle used for whole milk than skimmilk?
2. Why is a little more acid used than in the whole milk test?
3. How many pounds of fat in 1700 pounds of skimmilk with the above test? In 2500 pounds of whey with the above test?
4. Give length of time for both tests.

Grade . . . . .

Date . . . . .

(26)

EXERCISE 9.

OBJECT.—To determine the percentage of fat in buttermilk.

APPARATUS.—Sample of buttermilk; two skimmilk bottles; two whole milk bottles; pipette; acid measure; mixing beakers, and acid.

Step 1. Measure out first 17.6 cc. of buttermilk in each of the skimmilk bottles; also make up duplicate tests of buttermilk in whole milk bottles, as buttermilk may be too high in fat content for skimmilk bottles.

Step 2. Complete the tests as before. Read the test which is the most accurately measured.

*Report.*

Buttermilk in skim- milk bottle No....									
% of fat $\left\{ \begin{array}{l} A \\ B \end{array} \right. \dots\dots$									
Buttermilk in whole milk bottle No....									
% of fat $\left\{ \begin{array}{l} A \\ B \end{array} \right. \dots\dots$									

At the bottom of the page explain—

1. Why are two sets of bottles used for the buttermilk test?
2. Why is a little more acid used than with the whole milk test?
3. How many pounds of fat in 1700 pounds of buttermilk with the above test? (Show operation.)

## EXERCISE 10.

(27)

**OBJECT.**—To determine the specific gravity of milk.

**APPARATUS.**—Lactometer; lactometer cylinder; thermometer, and sample of milk.

Step 1. Thoroughly mix sample of milk and regulate temperature between 60° and 70° F.

Step 2. Fill cylinder nearly full of sample of milk. Place lactometer in sample and observe exact reading on lactometer after it has become still.

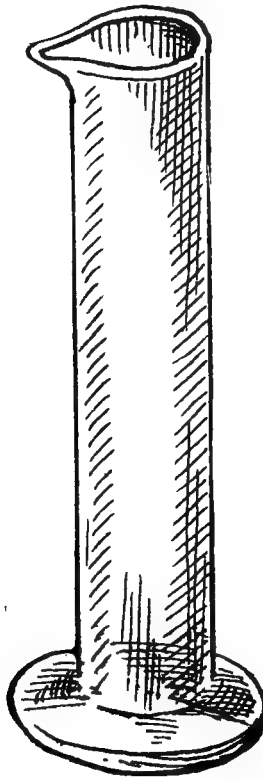
Caution.—Care is necessary to not let the lactometer drop in the cylinder, as the lactometer is very easily broken.

Step 3. Record exact temperature of sample and lactometer reading.

Step 4. Test sample by Babcock method for fat content.



Lactometer.



Lactometer cylinder.

*Report.*

Sample No.	Temperature	Lactometer reading	Reading corrected for temperature	% fat

1. Calculate the solids not fat and the total solids from the above data.  
(For figuring total solids and solids not fat see rules 6, A and B.)
2. What are solids not fat?
3. What is the specific gravity of normal cows' milk?
4. Why is it necessary to make the correction in the lactometer when the temperature is other than  $60^{\circ}$ ?
5. When milk is heated, what is the effect on its specific gravity?
6. How does cooling milk affect the specific gravity?

Grade .....

Date .....

EXERCISE 11.

(29)

OBJECT.—To determine the total solids and the solids not fat in milk.

APPARATUS.—Babcock test outfit; lactometer and equipment; a sample of whole milk.

Step 1. Regulate temperature of whole milk sample until near 60° F. Pour into cylinder and carefully take lactometer reading.

Step 2. Make a Babcock test for fat. Record all data, and by rules 6, *A* and *B* figure out the total solids and solids not fat for the sample. Repeat for a second sample.

*Report.*

	Lac. reading corrected for temp.	% fat		Solids not fat	Total solids
		A	B		
Sample No. 1 .....					
Sample No. 2 .....					

1. What would be the total solids in a sample having a lactometer reading of 32.6 at 68° F. and a fat test of 3.8 per cent?

2. How many pounds of solids not fat in 400 pounds of this milk?





1. Calculate the solids not fat in a sample of milk testing 3.6 per cent fat, with a lactometer reading of 34 at 52° F.
2. What are the solids not fat in a sample of milk testing 2.8 per cent fat, with a lactometer reading of 26 at 60° F.?
3. Is this sample adulterated?
4. If this sample has been adulterated, what has probably been used as an adulterant?
5. What makes you think this?

Grade .....

Date .....

(32)

EXERCISE 13

OBJECT.—To determine the effect of not mixing a sample previous to testing.  
APPARATUS.—Sample of milk that has stood for an hour or two without being stirred; the Babcock test outfit.

Step 1. Without disturbing the sample of milk on the desk, draw two samples from the top.

Step 2. Draw two samples from the bottom.

Step 3. Mix the milk thoroughly by pouring; take two samples.

Step 4. Add proper amount of acid to each, mix and complete the tests.

*Report.*

	Before mixing				After mixing	
	Top		Bottom		A	B
	A	B	A	B		
Bottle No . . . . .						
% of fat . . . . .						

1. Explain below what would be the losses to a creamery receiving 45,000 pounds of milk daily if the above careless methods were used in testing the samples, supposing the sample was taken from the top.

2. What loss to patron if sample is taken from bottom?

3. What would be the percentage of error in the above tests?

## EXERCISE 14.

(33)

OBJECT.—To determine effect of temperature when reading the fat test.

APPARATUS.—Sample of cream; whole milk; skimmilk; Babcock test outfit.

Step 1. Measure out two bottles of whole milk, two of skimmilk. Put 9 grams of cream into each of two cream bottles.

Step 2. Add proper amounts of acid, mix and complete the tests.

Step 3. Take reading as soon as whirling is complete.

Step 4. Temper the water bath to 200° F. Insert the bottles so the water comes near the top. After being inserted five minutes, read.

Step 5. Lower the water to 150° F., after five minutes read.

Step 6. Lower to 130° F. and, after five minutes, read.

Step 7. Lower the water to 90° F. and, after five minutes, read.

*Report.*

	Whole milk		Skimmilk		Cream	
	A	B	A	B	A	B
Bottle No . . . . .						
First reading % fat. . . . .						
200° % fat. . . . .						
150° % fat. . . . .						
130° % fat. . . . .						
90° % fat. . . . .						

1. Which is the proper reading and why?
2. What would be the loss to a creamery taking in 30,000 pounds of cream if the test was read, as in step 4, at 200°?
3. What loss to patron if read, as in step 7, at 90°?
4. Give variation in the color of the fat at the different stages.

Grade .....

Date .....

(34)

EXERCISE 15.

OBJECT.—To determine the effect of speed of the tester upon the test.

APPARATUS.—Samples of whole milk; skimmilk; Babcock test outfit.

Step 1. Prepare three test samples of whole milk.

Note.—In this exercise have all conditions alike except speed.

Step 2. Prepare three test samples of skimmilk using skimmilk bottles.

Step 3. To the skimmilk add a little more than a full measure of acid. Mix as usual.

Step 4. Run one bottle of whole milk and one of skimmilk at half speed; one of each at proper speed; one of each at high speed.

*Report.*

	Speed	Whole milk % fat	Skimmilk % fat
At half speed .....			
At proper speed .....			
At high speed .....			

At the bottom of the page explain—

1. The effects on the color of the fat.
2. Other effects of insufficient speed.
3. Other effects of too much speed.

Grade .....

Date .....

EXERCISE 16.

(35)

OBJECT.—To determine the effect of varying amounts of acid in the Babcock test.

APPARATUS.—Sample of whole milk; Babcock outfit.

Step 1. To one sample add the regular measure of acid.

Step 2. To another add half the regular amount of acid, 8.8 cc.

Step 3. To another add 1 1/2 measures of acid, 26.3 cc.

Step 4. Mix and test in the usual way.

*Report.*

	Regular measure	Half measure	1 1/2 measure
Bottle No.....			
% fat.....			

1. What is the effect of insufficient acid?
2. Of too much acid?
3. Write a full description of clearness, color and correctness.

Grade .....

Date .....

(36)

EXERCISE 17.

OBJECT.—To determine the effect of temperature of milk and incomplete mixing of acid and milk.

APPARATUS.—Sample of whole milk; Babcock test outfit.

Step 1. Measure out two samples, add acid at once and mix thoroughly (usual method).

Step 2. Measure out two samples, place in water bath at 130° for ten minutes; then add acid and rotate to dissolve curd.

Step 3. Measure out two samples, add acid but allow same to stand ten minutes before dissolving curd.

Step 4. Complete all tests.

*Report.*

	Usual method		Too hot		Stood too long	
	A	B	A	B	A	B
Bottle No . . . . .						
% fat . . . . .						

Explain below—

1. The effect of having the sample too hot before adding the acid.
2. The effects of allowing the sample to stand with the acid on it before mixing.
3. Give the different colors of fat in the tests above and give reasons for these changes.

Grade . . . . .

Date . . . . .

EXERCISE 18.

(37)

OBJECT.—To determine the effect of measuring cream as compared with weighing it.

APPARATUS.—Sample of cream; Babcock outfit; 2 9-gram and 4 18-gram cream bottles.

Step 1. Measure into each of two 18-gram bottles 17.6 cc. of cream.

Step 2. Add 17.5 cc. of acid, rotate well and allow to stand until mixture turns black, then add hot water up to the neck of the bottle.

Step 3. Weigh out 18 grams of cream into each of two 18-gram bottles. Add acid and water as in step 2.

Step 4. Weigh into each of two 9-gram bottles 9 grams of cream and test in the usual manner.

Report.

	17.6 cc. cream		18 grams cream		9 grams cream	
	A	B	A	B	A	B
Bottle No . . . . .						
% fat . . . . .						

1. Which test should be the correct one?

2. Give the advantages and disadvantages of weighing out cream for a test.

3. With how many pounds of fat would a cream patron be over-credited if he delivered 467 pounds of cream and was allowed the highest test?

4. How much would he be short if paid by the lowest test, butter being worth 30 cents per pound, overrun being 14 per cent?

Grade .....

Date .....

(38)

EXERCISE 19.

OBJECT.—To determine the effect of adding water before whirling in the 9-gram cream test.

APPARATUS.—Sample of cream; Babcock test outfit.

Step 1. Weigh into each of two 18-gram bottles 18 grams of cream.

Step 2. Weigh into each of two 9-gram bottles 9 grams of cream.

Step 3. Add the proper amount of acid to each lot. After standing a few minutes add hot water to one half of each lot.

Step 4. Mix and finish the tests.

Report.

	18 grams no water		18 grams with water		9 grams no water		9 grams with water	
	A	B	A	B	A	B	A	B
Bottle No.								
% fat. ....								

Write a full description of the variations in the above tests with reasons for (a) color, (b) clearness, and (c) correctness of the fat test.



Grade .....

Date .....

EXERCISE 20.

(39)

OBJECT.—To test butter for percentage of fat.

APPARATUS.—Sample of butter; Babcock test outfit.

Step 1. Preparing sample.—Put a fair sample into a tightly stoppered bottle. Put the bottle into water at 95° F. and shake thoroughly until melted. Then put the bottle into cold water and shake well until butter becomes of a thick, creamy consistency. From this sample small portions may be taken for testing.

Step 2. Testing.—Weigh 9 grams of butter into each of two bottles graduated to 50 per cent, add 10 cc. of hot water, and about 8.5 cc. of acid. Mix until all the curd is dissolved. Add hot water to bring the fat into the neck of the bottle. Whirl in a centrifuge for five minutes and read. The reading multiplied by 2 will be the correct test.

Report.

	A	B	A	B	A	B	A	B	A	B
Bottle No. ....										
% fat. ....										

1. If butter contains 80 per cent fat what should be the percentage of overrun?
2. What is the average composition of butter?
3. What is the percentage of butterfat allowed by law?

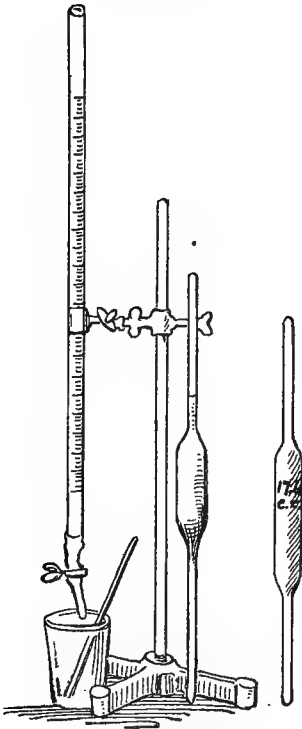
(40)

EXERCISE 21.

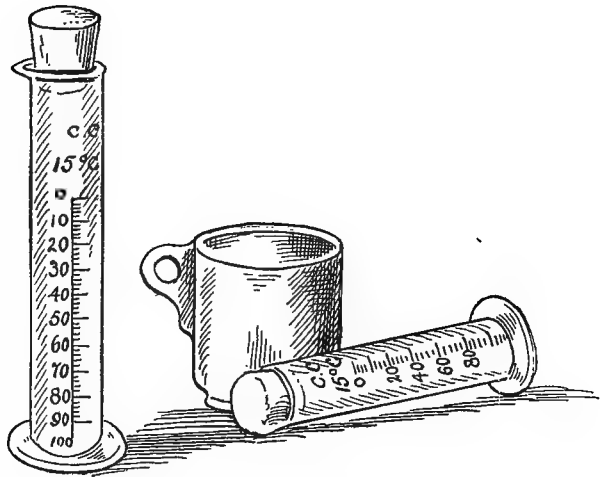
OBJECT.—To note the acidity of milk products, and to compare the method of determining the acidity.

APPARATUS.—Sample of milk; cream; cheese; skim milk; buttermilk; Farrington's, Mann's and Van Norman's apparatus; solution for acidity tests.

Step 1. Follow the printed directions for the particular test being used. (See rule 6.)



Apparatus for acid test.



Farrington's acid test apparatus.

*Report.*

	Sample	Percentage acidity		Mann's Degrees	Calculate % by Mann's
		Farrington's	Van Norman's		
Milk A.....					
Milk B.....					
Cream A.....					
Cream B.....					
Skimmilk A....					
Skimmilk B....					
Buttermilk A .					
Buttermilk B .					
Cheese A.....					
Cheese B.....					

Write the advantages and disadvantages of each test.

(42)

## EXERCISE 22

OBJECT.—To standardize milk and cream.

APPARATUS.—Sample of milk and cream; Babcock test outfit; sample bottles; cream scales.

Step 1. Run test for fat on both cream and milk samples.

Step 2. Standardize 100 grams of 4 per cent milk from the tested cream and whole milk samples.

Step 3. Standardize 100 grams of 20 per cent cream from the tested whole milk and cream samples.

Step 4. Run fat tests on all standardized samples and record data.

*Report.*

Bottle No. ....	A	B	Step 2. Grams used		Step 3. Grams used	
			Milk	Cream	Milk	Cream
Test of whole milk.....						
Test of cream.....						
Test after step 2.....						
Test after step 3.....						

Work out the following problems—

1. One thousand pounds of 3.6 per cent milk is to be raised to 4 per cent milk; how much skimmilk must be taken out?

2. How much 30 per cent cream and skimmilk must be used to make up 1000 pounds of 25 per cent cream?

3. How much 36 per cent cream and 3.6 per cent milk must be used to make up 800 pounds of 25 per cent cream?

4. How many pounds of 40 per cent cream and 4 per cent milk must be used to make up 90 pounds of 20 per cent cream?

Grade.....

Date. . . . .

EXERCISE 23.

(43)

OBJECT.—To prepare a commercial starter.

APPARATUS.—A pint bottle, sterilized; a sample of commercial starter; a sterilized graduated cylinder; a sample of pasteurized skimmilk; a thermometer.

Step 1. Measure out 25 cc. of the commercial starter into a sterilized pint bottle. Add to it 225 cc. of pasteurized skimmilk at a temperature of 80° F.

Step 2. Place cover on bottle and set away in starter box at a temperature of 70° F. for 24 hours. Hold at this temperature until all changes have been noted.

Step 3. Record all the changes which a starter undergoes from the time it is made up until observations are complete.

1. Write a full description of a starter and all the changes which take place in its manufacture.
2. Explain as fully as possible the reasons for each change.
3. Give briefly the advantages of using a starter.

Grade .....

Date .....

(44)

EXERCISE 24.

OBJECT.—To learn the correct use of milk coolers.

APPARATUS.—Quantity of water or milk; milk cooler; supply of milk cans; thermometers.

Step 1. Weigh out 100 pounds of the milk or water and have the temperature about that of milk when taken from the barn, 90°. Place in the cooler vat.

Step 2. Arrange the cold water inflow to give full flow, take the temperature of inflow, of outflow, and length of time to cool the milk to 50° and the amount of water needed. Record data below.

Step 3. Same as step 1 and 2 except have water passing through the cooler with only half pressure. Record data.

Step 4. Same as step 1 and 2, only determine the length of time and amount of water necessary to cool to within 3 degrees of the temperature of the water. Take temperature of inflow and outflow in all cases.

*Report.*

	Temp. milk	Temp. inflow	Temp. outflow	Time	Amt. water required	Temp. when cooled
Step 2 .....						
Step 3 .....						
Step 4 .....						

Grade .....

Date .....

EXERCISE 25.

(45)

OBJECT.—To make a comparative study of cream separators.

APPARATUS.—Separators in separator room.

Steps. Study several separators and fill the record columns correctly.

Record.

1. Name of separator .....			
2. Factory number. . . . .			
3. Size number.....			
4. Revolutions of bowl per one turn of crank.....			
5. Speed of crank.....			
6. Speed of bowl.. . . .			
7. Rated capacity.. . . .			
8. No. of gears.....			
9. No. of bearings.....			
10. Ratchet located.....			
11. No. parts in bowl.....			
12. Weight of bowl.....			
13. Bowl No.....			
14. Height of top of receiving tank from floor.....			
15. Height of crank spindle from floor.....			
16. Height of crank handle from floor at lowest position.....			
17. Milk enters bowl.....			
18. Skimmilk leaves bowl. . . . .			
19. Which is cream spout?.....			
20. Pressure of worm gear, down or up?..			

Write a criticism of each machine studied—give its special advantages and its disadvantages.

Grade .....

Date .....

(46)

### EXERCISE 26.

OBJECT.—Comparative study of separators.

APPARATUS.—Separators in separator room.

PROCEDURE.—Carefully remove the neck bearing which is located in the upper seating for the bowl. Study the character of the bearing with regard to the points indicated below. When through, carefully replace and adjust the bearings before leaving the machine. Follow the same instructions for the bottom bearing which is located at the lower seating of the spindle.

#### *Report.*

Name of separator	Neck-bearing Character of spring; crown, spiral, wire or ribbon; adjustable or non-adjustable?	Bottom-bearing Flat or sharp, pin on point, or both, or balls? Is it a weight-carrying or guide-bearing? Adjustable as to height?
.....		
.....		
.....		
.....		
.....		
.....		
.....		
.....		
.....		
.....		
.....		
.....		
.....		
.....		
.....		

At the bottom of the page make criticism as to ease of removing and replacing the bearings, of each of the machines studied.



Grade .....

Date .....

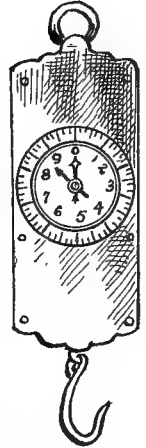
EXERCISE 27.

(47)

OBJECT.—To determine the capacity of separators.

APPARATUS.—Two large dippers; 2 fourteen quart pails; a quantity of milk. (Two or more students may work together.)

Step 1. See that the milk is at the right temperature, 90° to 98° F., and that there is a sufficient amount to maintain a full flow during the experimental run. Start separating, and catch the first cream and skimmilk in dippers. When the milk is running a normal flow, take the dippers away and let the skimmilk and cream run into the regular pails for exactly one minute. Take them away and let the rest of the milk run into the dippers. Weigh up the amount of skimmilk and cream which was caught in the one-minute experimental run. Compute the capacity per hour. Flush bowl with warm rinse water. Save samples of skimmilk and cream.



Spring balance for weighing milk.

Report.

1. Name of separator.....
2. Size.....
3. Rated capacity per hour.....
4. Record speed of handle three times .....
5. Temperature of milk at start;..... at finish.....
6. Pounds of skimmilk, ..... 1 min.; ..... 1 hour.....
7. Pounds of cream,..... 1 min.; ..... 1 hour.....
8. Pounds of skimmilk and cream, ... 1 min.; ..... 1 hour.....

Below show how long it would take each day to separate the milk from thirty cows, each giving 35 pounds daily, with a machine of a capacity of the above machines.

Grade .....

Date .....

(48)

EXERCISE 28.

OBJECT.—To adjust height of bowl and position of cream screw.

APPARATUS.—Separators in separator room; quantity of whole milk.

Step 1. Name of separator.

Step 2. See that height of bowl is such as to deliver skimmilk and cream into their respective covers without touching them. Before making any adjustment, study direction sheet for this machine thoroughly.

Step 3. With sufficient milk (or water) in supply can to maintain full flow, separate at least one gallon, shut off supply, weigh and compute what proportion the cream is of the total amount separated.

Step 4. Adjust cream screw to make the amount of cream between 12 and 14 per cent of the total separated.

Step 5. If already correct, adjust so as to make a change of between 4 and 6 per cent.

*Report.*

	1st trial	2nd trial	3rd trial
Skimmilk, pounds .....			
Cream, pounds .....			
Total, pounds .....			
% of total taken as cream .....			

Explain below—

1. How much change was made in the cream screw?
2. How does the cream screw affect the amount of cream?
3. How does it affect the amount of fat?
4. When water is separated, would the amount of water leaving the cream spout be the same as the amount of cream when milk is separated?
5. Give reason for your answer.

Grade .....

Date .....

EXERCISE 29.

(49)

**OBJECT.**—To determine the effect of speed variations on the proportion of cream, richness of cream, and on the loss of fat in skim milk.

**APPARATUS.**—Separators in separator room; quantity of whole milk.

Step 1. Have milk at 90° to 98° F.

Step 2. Separate half the milk at regular speed.

Step 3. Separate remaining half with speed reduced one-third.

Step 4. Save sample of whole milk; also samples of cream and skim milk from both two and three.

*Report.*

Name of separator ..... Size .....

	First trial		Second trial	
	1st half	2nd half	1st half	2nd half
Pounds of milk used .....				
Temperature of milk .....				
Note speed three times .....				
Pounds rinse water used .....				
Pounds skim milk .....				
Pounds cream .....				
Pounds skim milk and cream ..				
Proportion of cream .....				
Test of whole milk .....				
Test of cream .....				
Test of skim milk .....				
Pounds butterfat in milk .....				
Pounds butterfat in skim milk ..				
Pounds butterfat in cream .....				
Pounds fat unaccounted for ....				
% fat unaccounted for .....				

Write the reasons and effects of the variations that you have found in this exercise.

Grade .....

Date .....

(50)

EXERCISE 30.

OBJECT.—To determine the influence of the change of inflow on the proportion and richness of cream, and the loss of fat in the skimmilk.

APPARATUS.—Separators in separator room; quantity of whole milk.

Step 1. Separate half the milk with faucet wide open and speed uniform.

Step 2. Separate the other half, starting with faucet wide open, then close till cream becomes noticeably thicker.

NOTE.—Maintain correct and uniform speed. Save samples and test.

Report.

Name of separator .....Size .....

	First trial		Second trial	
	1st half	2nd half	1st half	2nd half
Pounds of milk used .....				
Temperature of milk .....				
Note speed three times .....				
Pounds rinse water used .....				
Pounds skimmilk .....				
Pounds cream .....				
Pounds skimmilk and cream .....				
Proportion of cream .....				
Test of whole milk .....				
Test of cream .....				
Test of skimmilk .....				
Pounds butterfat in milk .....				
Pounds butterfat in skimmilk .....				
Pounds butterfat in cream .....				
Pounds fat unaccounted for .....				
% fat unaccounted for .....				

Write the reasons and effects of the variations that you have found in this exercise.

Grade .....

Date .....

EXERCISE 31.

(51)

OBJECT.—To determine the effect of variations in temperature of milk and proportion and richness of cream and loss of fat.

APPARATUS.—Separator in separator room; quantity of whole milk.

Step 1. Separate half the milk at about 90° F.

Step 2. Separate half the milk at about 50° F.

NOTE.—Maintain correct and uniform speed. Save samples and test.

Report.

Name of separator ..... Size.....

	First trial		Second trial	
	1st half	2nd half	1st half	2nd half
Pounds of milk used .....				
Temperature of milk .....				
Note speed three times .....				
Pounds rinse water used .....				
Pounds skim milk .....				
Pounds cream .....				
Pounds skim milk and cream ...				
Proportion of cream .....				
Test of whole milk .....				
Test of cream .....				
Test of skim milk .....				
Pounds butterfat in milk .....				
Pounds butterfat in skim milk ..				
Pounds butterfat in cream .....				
Pounds fat unaccounted for ...				
% fat unaccounted for .....				

Write the reasons and effects of the variations that you have found in this exercise.

(52)

## EXERCISE 32.

**OBJECT.**—To churn butter from ripened cream (first churning exercise).

**APPARATUS.**—Churn; cream; scales; thermometer; pails; salt; color; etc.

(Two or more students may work together in all churning exercises.)

**NOTE.**—Students going into the laboratory should first note the work to be done, which will be found on the slip on the bulletin board or on the blackboard.

**General Instructions for Churning.**—The principle of churning is the proper agitation of the cream that the butterfat which is in it is properly and thoroughly separated out.

Before churning, the cream should be properly ripened. That is, it should have been held at the proper temperature that the right amount of acidity may have developed in it.

The cream should have an acidity of from .3 to .5 per cent and be held at the temperature required for churning at least two hours before churning. The churning temperature will necessarily vary in the different seasons, but should run about 52–54 in the summer and 54–58 in the winter.

The churn should be thoroughly scalded out to remove bad odors or taints and then cooled down with cold water. The cream should then be weighed and placed in the churn and the churning process started.

If a barrel churn, churn until the butter begins to break in small granules about the size of a grain of corn. Here the churning should stop. It should take not over 30 minutes to reach this stage if the cream was properly handled before starting to churn. If it takes less than 15 minutes it may mean that the churning temperature was too hot.

Draw off the buttermilk through a sieve that the small particles of butter may not be lost. Take the temperature of the buttermilk. Pour over the butter, in the churn, about the same amount of water as cream used in the churning and from 4° to 10° cooler than the buttermilk. Rinse the butter in this water for about 15 to 20 revolutions of the churn. Draw off the water, and take the butter out on the working board and salt, using about one ounce of salt to the pound of butter. The salting may be done in the churn if it has a worker.

After salting, allow the salt to dissolve, then work the butter until the salt is in all parts and the buttermilk is out. Print and wrap in clean parchment paper.

Wash and scald all utensils and leave hot to dry.

**Student A.** Weigh out the cream for churning; get the temperature right, add butter-color if necessary, place cream in churn; make all necessary observations, record data; scald the butterworker and other woodenware and then chill thoroughly with cold water; get the necessary rinse water and have it at the right temperature. Weigh the salt and have things ready when churning is done. Draw off buttermilk, rinse butter, place butter on worker, salt, work and print. Finish recording data. (Record all data on the following page.)

**Student B.** Scald the churn with hot water and then chill thoroughly with cold water. Run the churn, take samples of buttermilk and wash up the churn. In washing up the churn rinse with luke-warm water and then wash thoroughly with scalding water and washing powder and

scald with clear water. Use brush on the outside of the churn. Leave the churn hot. Wrap the butter, wash the butterworker, other woodenware, and pails in the same manner as the churn was washed. See that the floor is clean and dry and that each piece of apparatus is clean and in its place. *Unclean or misplaced* apparatus will count heavily against good butter making.

### CHURNING RECORD.—*Churning No.*.....

This blank should be neatly and accurately filled out when the product is finished.

Condition of cream.....  
 Total pounds of fat.....  
 Temperature at which cream was ripened.....  
 Time to ripen.....  
 Length of time held at churning temperature.....  
 % of fat in cream when churned.....  
 Kind and size of churn used.....  
 Approximate fullness of churn.....  
 Temperature churned.....  
 Time to churn.....  
 Amount of color used.....  
 Size of granules when churning stops.....  
 Temperature of buttermilk..... Test.....  
 Amount of wash water.....  
 Temperature of wash water.....  
 Amount of salt used.....  
 Brine or dry salted.....  
 Butter from churn hard or soft.....  
 Pounds of butter.....  
 Pounds of overrun.....  
 % overrun.....  
 Work and observations by.....  
 Assisted by.....

Make special notes regarding this churning operation.

Grade .....

Date .....

(54)

EXERCISE 33.

OBJECT.—To churn and make a good grade of butter from well ripened cream. (Second churning exercise.)

APPARATUS.—The same as for Exercise 32.

Step 1. Follow closely Exercise 32. (The two students may trade work.)

CHURNING RECORD.—*Churning No.*.....

This blank should be neatly and accurately filled out when the product is finished.

Condition of cream.....

Total pounds of fat .....

Temperature at which cream was ripened .....

Time to ripen .....

Length of time held at churning temperature.....

% of fat in cream when churned.....

Kind and size of churn used.....

Approximate fullness of churn.....

Temperature churned.....

Time to churn.....

Amount of color used.....

Size of granules when churning stops.....

Temperature of buttermilk..... Test.....

Amount of wash water.....

Temperature of wash water .....

Amount of salt used.....

Brine or dry salted.....

Butter from churn hard or soft.....

Pounds of butter.....

Pounds of overrun .....

% overrun .....

Work and observations by .....

Assisted by.....

Make special notes regarding this churning operation.



Grade .....

Date .....

EXERCISE 34.

(55)

OBJECT.—To see the effect of churning at a high churning temperature and washing at a low temperature.

APPARATUS.—Same as for other churning exercises.

Step 1. Have temperature of cream at 58° to 60° F., rinse water 45° to 50°.

CHURNING RECORD.—*Churning No.*.....

This blank should be neatly and accurately filled out when the product is finished.

Condition of cream.....

Total pounds of fat .....

Temperature at which cream was ripened.....

Time to ripen .....

Length of time held at churning temperature.....

% of fat in cream when churned.....

Kind and size of churn used.....

Approximate fullness of churn .....

Temperature churned.....

Time to churn.....

Amount of color used.....

Size of granules when churning stops .....

Temperature of buttermilk..... Test .....

Amount of wash water.....

Temperature of wash water .....

Amount of salt used.....

Brine or dry salted.....

Butter from churn hard or soft.....

Pounds of butter.....

Pounds of overrun .....

% overrun .....

Work and observations by .....

Assisted by.....

Make special notes regarding this churning operation.

Grade .....

Date .....

(56)

EXERCISE 35.

OBJECT.—To see the effects of a low churning temperature and a high washing temperature.

APPARATUS.—Same as for other churning exercises.

Step 1. Have cream at 48° to 50° F.; rinse water 56° to 58°.

Write fully the evil effects of the above practice.

CHURNING RECORD.—*Churning No.*.....

This blank should be neatly and accurately filled out when the product is finished.

Condition of cream.....

Total pounds of fat.....

Temperature at which cream was ripened.....

Time to ripen.....

Length of time held at churning temperature.....

% of fat in cream when churned.....

Kind and size of churn used.....

Approximate fullness of churn.....

Temperature churned.....

Time to churn.....

Amount of color used.....

Size of granules when churning stops.....

Temperature of buttermilk..... Test.....

Amount of wash water.....

Temperature of wash water.....

Amount of salt used.....

Brine or dry salted.....

Butter from churn hard or soft.....

Pounds of butter.....

Pounds of overrun.....

% overrun.....

Work and observations by.....

Assisted by.....

Make special notes regarding this churning operation.

Grade .....

Date .....

EXERCISE 36.

(57)

OBJECT.—To determine the effect of churning very thick cream.

APPARATUS.—Same as for other churning exercises.

Step 1. Have cream 35 to 40 per cent fat.

CHURNING RECORD.—*Churning No.*.....

This blank should be neatly and accurately filled out when the product is finished.

Condition of cream.....  
Total pounds of fat.....  
Temperature at which cream was ripened.....  
Time to ripen.....  
Length of time held at churning temperature.....  
% of fat in cream when churned.....  
Kind and size of churn used.....  
Approximate fullness of churn.....  
Temperature churned.....  
Time to churn.....  
Amount of color used.....  
Size of granules when churning stops.....  
Temperature of buttermilk..... Test.....  
Amount of wash water.....  
Temperature of wash water.....  
Amount of salt used.....  
Brine or dry salted.....  
Butter from churn hard or soft.....  
Pounds of butter.....  
Pounds of overrun.....  
% overrun.....  
Work and observations by.....  
Assisted by.....

Make special notes regarding this churning operation.

Grade .....

Date .....

(58)

EXERCISE 37.

OBJECT.—To see the effects of over-working butter.

APPARATUS.—Same as in other churning exercises.

Step 1. Churn and otherwise care for the cream as in the first churning exercises until the butter is ready to work.

Step 2. Work butter until it seems to be worked enough; note its condition. Break a few lumps and note the grain. Then continue working, noting the condition of the butter every five revolutions of the worker. Continue working until the butter is much over-worked. Record data.

*Report.*

Well worked.....  
Additional 5 revolutions.....  
10 revolutions.....  
15 revolutions.....  
20 revolutions.....  
25 revolutions.....  
30 revolutions.....  
35 revolutions.....

Make special notes regarding this churning operation. Make record on following page.

CHURNING RECORD.—*Churning No.*.....

This blank should be neatly and accurately filled out when the product is finished.

Condition of cream.....  
 Total pounds of fat.....  
 Temperature at which cream was ripened.....  
 Time to ripen.....  
 Length of time held at churning temperature.....  
 % of fat in cream when churned.....  
 Kind and size of churn used.....  
 Approximate fullness of churn.....  
 Temperature churned.....  
 Time to churn.....  
 Amount of color used.....  
 Size of granules when churning stops.....  
 Temperature of buttermilk..... Test.....  
 Amount of wash water.....  
 Temperature of wash water.....  
 Amount of salt used.....  
 Brine or dry salted.....  
 Butter from churn hard or soft.....  
 Pounds of butter.....  
 Pounds of overrun.....  
 % overrun.....  
 Work and observations by.....  
 Assisted by.....

Make special notes regarding this churning operation.

(60)

## EXERCISE 38.

**OBJECT.**—To note the effect of over-churning on the quality of the butter produced.

**APPARATUS.**—Same as in other churning exercises.

**Step 1.** Proceed as in a regular churning until butter comes the size of corn grain. Then continue churning until the butter has collected in large masses. Finish churning operations as usual. Record data on the following page but make observations on this page.

1. What will be the effect on the keeping quality of the butter when over-churned?

2. What constituents of the butter will likely be raised in their percentage?

3. Will more or less working of the butter be required to remove the buttermilk from butter that has been over-churned?

4. Will the grain, or texture, be thus improved or would it be more "salvy"?

5. What caution would you give regarding the extent of churning for butter that is to be stored and shipped long distances?

CHURNING RECORD.—*Churning No.*.....

This blank should be neatly and accurately filled out when the product is finished.

Condition of cream.....

Total pounds of fat.....

Temperature at which cream was ripened.....

Time to ripen.....

Length of time held at churning temperature.....

% of fat in cream when churned.....

Kind and size of churn used.....

Approximate fullness of churn.....

Temperature churned.....

Time to churn.....

Amount of color used.....

Size of granules when churning stops.....

Temperature of buttermilk..... Test.....

Amount of wash water.....

Temperature of wash water.....

Amount of salt used.....

Brine or dry salted.....

Butter from churn hard or soft.....

Pounds of butter.....

Pounds of overrun.....

% overrun.....

Work and observations by.....

Assisted by.....

Make special notes regarding this churning operation.

Grade .....

Date .....

(62)

EXERCISE 39.

OBJECT.—The effect of churning cream at different stages of ripening.

APPARATUS.—Same as for other churning exercises, with cream as described in the following note.

Note to Instructor.—Divide the class of students into about four groups, and have previously prepared four equal churnings of cream, part 1, fresh unripened, part 2, having .2 per cent of acidity, part 3, with .4 per cent acidity, and part 4, with as high as .7 per cent if possible. Have the cream all of the same percentage of fat and same temperature. Each group should churn the cream under the same conditions and in the same type of churn.

The data and results should be recorded on the following page. The differences in the churnings for the different groups should be recorded below.

Part No.	Time required for churning	% fat in butter-milk	Flavor of butter
1. Fresh cream .....			
2. .2% acid .....			
3. .4% acid .....			
4. About .7% acid .....			

1. Can you discover evidence of curds in any of the lots of butter after working?
2. Which lots would probably keep best, if stored for some time?



CHURNING RECORD.—*Churning No.*.....

This blank should be neatly and accurately filled out when the product is finished.

Condition of cream.....

Total pounds of fat.....

Temperature at which cream was ripened.....

Time to ripen.....

Length of time held at churning temperature.....

% of fat in cream when churned.....

Kind and size of churn used.....

Approximate fullness of churn.....

Temperature churned.....

Time to churn.....

Amount of color used.....

Size of granules when churning stops.....

Temperature of buttermilk..... Test.....

Amount of wash water.....

Temperature of wash water.....

Amount of salt used.....

Brine or dry salted.....

Butter from churn hard or soft.....

Pounds of butter.....

Pounds of overrun.....

% overrun.....

Work and observations by.....

Assisted by.....

Make special notes regarding this churning operation.

(64)

## EXERCISE 40.

OBJECT.—The scoring of butter.

APPARATUS.—Several samples of butter; score card; butter triers; paper, etc.

Step 1. Read carefully the score card and become thoroughly familiar with its points.

Step 2. Wipe trier carefully and insert into butter near centre of the package. Withdraw carefully, note condition of butter on the trier; also take the aroma of the sample.

Step 3. Take a part of the trier-full between the tongue and the roof of the mouth and let dissolve slowly, noting the flavor, salt, taints, etc. Record observations.

*Report.*

	Perfect score	Student's score	Criticisms
Flavor	45	.....	.....
Body	25	.....	.....
Color	15	.....	.....
Salt	10	.....	.....
Package	5	.....	.....
Flavor	45	.....	.....
Body	25	.....	.....
Color	15	.....	.....
Salt	10	.....	.....
Package	5	.....	.....
Flavor	45	.....	.....
Body	25	.....	.....
Color	15	.....	.....
Salt	10	.....	.....
Package	5	.....	.....

Give the reasons for the off flavors and defective body that may have been found in the above samples.

Grade .....

Date .....

EXERCISE 41.

(65)

OBJECT.—To determine the percentage of water in butter.

APPARATUS.—Set of balances; samples of butter; some type of moisture test device as the Ames, Irish, or Marshall test.

Step 1. Put samples of butter in clean dry bottles or jars with tight lids or caps, warm up, but do not entirely melt the sample, until it can be thoroughly mixed. Mix.

Step 2. Carefully weigh out 10 grams of the sample into a heated, weighed dish or cup; heat over the flame or in an oven at 175° to 180° F., until it ceases to lose weight.

Step 3. Take the difference between original weight and final weight and compute the percentage of moisture.

*Report.*

	Original weight	Final weight	Loss in weight	% of moisture
Sample No. 1 .....				
Sample No. 2 .....				
Sample No. 3 .....				
Sample No. 4 .....				

Grade .....

Date .....

(66)

**CHURNING RECORD.—***Churning No.*.....

This blank should be neatly and accurately filled out when the product is finished.

Condition of cream.....  
Total pounds of fat.....  
Temperature at which cream was ripened.....  
Time to ripen.....  
Length of time held at churning temperature.....  
% of fat in cream when churned.....  
Kind and size of churn used.....  
Approximate fullness of churn.....  
Temperature churned.....  
Time to churn.....  
Amount of color used.....  
Size of granules when churning stops.....  
Temperature of buttermilk..... Test.....  
Amount of wash water.....  
Temperature of wash water.....  
Amount of salt used.....  
Brine or dry salted.....  
Butter from churn hard or soft.....  
Pounds of butter.....  
Pounds of overrun.....  
% overrun.....  
Work and observations by.....  
Assisted by.....

Make special notes regarding this churning operation.

Grade .....

Date .....

(67)

CHURNING RECORD.—*Churning No.*.....

This blank should be neatly and accurately filled out when the product is finished.

Condition of cream.....

Total pounds of fat .....

Temperature at which cream was ripened .....

Time to ripen .....

Length of time held at churning temperature.....

% of fat in cream when churned.....

Kind and size of churn used.....

Approximate fullness of churn .....

Temperature churned.....

Time to churn.....

Amount of color used.....

Size of granules when churning stops .....

Temperature of buttermilk..... Test.....

Amount of wash water.....

Temperature of wash water .....

Amount of salt used.....

Brine or dry salted.....

Butter from churn hard or soft.....

Pounds of butter.....

Pounds of overrun .....

% overrun .....

Work and observations by .....

Assisted by.....

Make special notes regarding this churning operation.

Grade .....

Date .....

(68)

**CHURNING RECORD.—***Churning No.*.....

This blank should be neatly and accurately filled out when the product is finished.

Condition of cream.....

Total pounds of fat .....

Temperature at which cream was ripened.....

Time to ripen .....

Length of time held at churning temperature.....

% of fat in cream when churned.....

Kind and size of churn used.....

Approximate fullness of churn.....

Temperature churned.....

Time to churn.....

Amount of color used.....

Size of granules when churning stops.....

Temperature of buttermilk..... **Test**.....

Amount of wash water.....

Temperature of wash water.....

Amount of salt used.....

Brine or dry salted.....

Butter from churn hard or soft.....

Pounds of butter.....

Pounds of overrun.....

% overrun.....

Work and observations by.....

Assisted by.....

Make special notes regarding this churning operation.

Grade . . . . .

Date . . . . .

(69)

CHURNING RECORD.—*Churning No.* . . . . .

This blank should be neatly and accurately filled out when the product is finished.

Condition of cream . . . . .

Total pounds of fat . . . . .

Temperature at which cream was ripened . . . . .

Time to ripen . . . . .

Length of time held at churning temperature . . . . .

% of fat in cream when churned . . . . .

Kind and size of churn used . . . . .

Approximate fullness of churn . . . . .

Temperature churned . . . . .

Time to churn . . . . .

Amount of color used . . . . .

Size of granules when churning stops . . . . .

Temperature of buttermilk . . . . . Test . . . . .

Amount of wash water . . . . .

Temperature of wash water . . . . .

Amount of salt used . . . . .

Brine or dry salted . . . . .

Butter from churn hard or soft . . . . .

Pounds of butter . . . . .

Pounds of overrun . . . . .

% overrun . . . . .

Work and observations by . . . . .

Assisted by . . . . .

Make special notes regarding this churning operation.

Grade .....

Date .....

(70)

**CHURNING RECORD.—***Churning No.*.....

This blank should be neatly and accurately filled out when the product is finished.

Condition of cream.....

Total pounds of fat .....

Temperature at which cream was ripened .....

Time to ripen .....

Length of time held at churning temperature.....

% of fat in cream when churned.....

Kind and size of churn used.....

Approximate fullness of churn .....

Temperature churned.....

Time to churn.....

Amount of color used.....

Size of granules when churning stops .....

Temperature of buttermilk..... Test .....

Amount of wash water.....

Temperature of wash water .....

Amount of salt used.....

Brine or dry salted.....

Butter from churn hard or soft.....

Pounds of butter.....

Pounds of overrun .....

% overrun .....

Work and observations by .....

Assisted by.....

Make special notes regarding this churning operation.



1. What is the percentage of total solids in milk testing 4.9 and having a lactometer reading of 33 at 57° F.? (Rule 5, B.)
2. What would be the correct specific gravity of a sample of milk if the lactometer gave a reading of 32.5 at 65° F.? (Rule 12.)
3. What is condition of each of the following samples:
  - (a) Lactometer reading 32 at 58° F., and has 4 per cent fat.
  - (b) Lactometer reading 30 at 63° F., and has 3.5 per cent fat.
  - (c) Lactometer reading 27.4 at 69° F., and has 2.4 per cent fat.
4. How many pounds of solids not fat in 139 pounds of milk testing 3.9 per cent fat and having a lactometer reading of 29 at 69° F.?
5. How many pounds of total solids are there in 49 pounds of milk having a fat test of 4.17 per cent and a lactometer reading of 32.4 at 56° F.?
6. How many pounds of milk testing 3 per cent must be mixed with 140 pounds cream, testing 27 per cent, to make milk testing 5.1 per cent? (Rule 10.)
7. Two thousand pounds of milk testing 3.5 per cent fat, is to be made to test 4 per cent by adding milk that tests 5 per cent. How many pounds will be added? (Rule 12.)
8. One thousand pounds of cream testing 30 per cent is to be reduced to 20 per cent by adding whole milk testing 4 per cent. How many pounds of the milk must be added?
9. One thousand pounds of cream testing 30 per cent is to be reduced to 25 per cent by adding milk testing 2.5 per cent. How many pounds of the milk must be added?
10. One thousand pounds of cream testing 30 per cent is to be reduced to 25 per cent by adding skimmilk. How many pounds of skimmilk must be added?
11. Six hundred pounds of 30 per cent cream is wanted. Having cream on hand testing 40 per cent, and skimmilk, find how many pounds of each are needed to produce 600 pounds of 30 per cent cream.
12. How many pounds each of 50 per cent cream and 25 per cent cream must be mixed together to produce 1,000 pounds of cream testing 40 per cent?
13. One thousand pounds of cream testing 50 per cent is to be diluted to make it test 40 per cent, using cream testing 25 per cent. How many pounds of the 25 per cent cream must be added to give the desired test?
14. One thousand pounds of cream testing 25 per cent is to be raised to 40 per cent with cream testing 50 per cent. Find how many pounds of the 50 per cent cream must be added to the 25 per cent cream to make it test 40 per cent.

15. Received 800 pounds of butterfat in 20,000 pounds of 4 per cent milk. From this 975 pounds of butter was made. Find the true overrun, expressed both in percentage and in pounds.

16. Received 800 pounds butterfat which made 984.94 pounds of butter; allowing 1 per cent for mechanical losses, what was the percentage of overrun, after mechanical losses were deducted? (Rule 11.)

17. Received 800 pounds butterfat. Made 984.94 pounds butter. Loss 1.25 per cent. What was the overrun?

18. Butterfat received 800 pounds; butterfat in butter made 80.41 per cent. What is the overrun?

19. What is the percentage of overrun when 176 pounds fat makes 194 pounds butter? What is the percentage of fat in this butter?

20. What is the percentage of overrun if 1800 pounds of cream testing 33 per cent makes 667 pounds of butter.

21. If you had 15 pounds of butterfat in cream that is to be churned and 18 pounds of butter was made, what is the percentage of overrun?

22. If 1800 pounds of cream testing 33 per cent made 650 pounds of butter, what is the number of pounds overrun? The percentage of overrun?

23. How many pounds of butter would you get from 1000 pounds of cream, testing 23 per cent and having an overrun of 14 per cent?

24. When butterfat sells for 40 cents per pound, how much must be secured for 4 per cent milk wholesale to realize the same? Buttermilk and skimmilk selling for 25 cents per hundred.

25. From which of these methods of selling will the largest returns be secured? (a) 4 per cent milk at \$1.55 per hundred; (b) 20 per cent cream selling for 80 cents per gallon, with skimmilk worth 25 cents per hundred; (c) butter selling for 40 cents per pound, buttermilk and skimmilk at 25 cents per hundred, and an overrun of 18 per cent being secured; charges for butter manufacture being one and one-half cents per pound of butter.



