TESTING MILK

FOR

BUTTER FAT

BY

THE BABCOCK TEST

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Compiled by
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AN APPRECIATION.

"By means of the Babcock test, dairying has been developed from one of the most haphazard of industries to an exact and attractive business enterprise. The Babcock test has been so intimately connected with and largely responsible for the progress in dairying not only in this state but throughout the country and the world, that proficiency in its use has become almost synonymous with better cows, better milk and better farming.

"It has served as the necessary stimulant to raise dairying from a disliked side line to a profession worthy of the efforts of well trained men. It has made dairymen honest, has placed dairying on a scientific basis, has promoted factory efficiency and has stimulated the breeding up of productive herds.

"The Babcock test has struck the shackles which bound dairy farmers to past traditions, and has started them on their way to greater prosperity."

H. L. RUSSELL,
Director.
Wisconsin Experiment Station.

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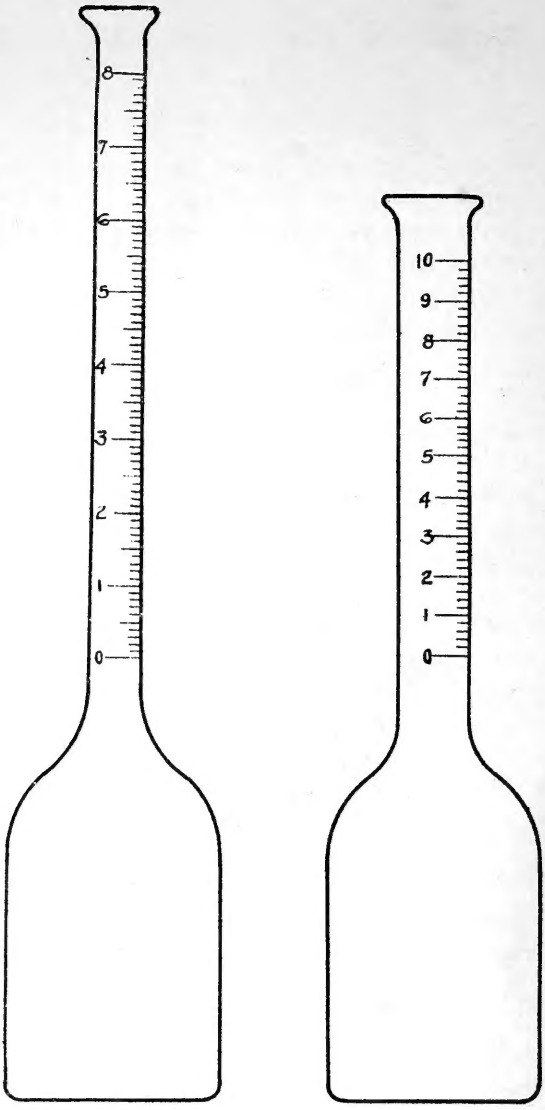


FIG. 1
Milk Testing Bottles

The eight per cent. bottle is graduated to tenths while the ten per cent. bottle is graduated to fifths. The use of the eight per cent. bottle is specified by the Official Dairy Instructors' Association, and as it makes possible more accurate readings, is used by many licensed testers. It also conforms to the requirements of the U. S. Bureau of Standards.

THE BABCOCK TEST FOR FAT IN MILK

INTRODUCTION.

SO many inquiries are made about the Babcock Test for Fat in Milk it would appear that the subject is not yet fully understood by all. Many seem to think that the Babcock Test is a complicated process and at best unreliable. This is an erroneous idea. The test is simple, accurate and easily mastered by any one who will give the matter careful study and attention.

THEORY OF THE TEST.

Owing to the lightness of the fat globules they tend to rise to the surface to form a layer of cream, but because of the other solids in the milk, the fat globules do not all succeed in getting to the top. It was found that sulphuric acid would dissolve the other milk solids without affecting the fat globules and would thus permit them to rise to the top more readily.

Just as a wagon wheel throws the mud from the tires when the horses are going rapidly, so by whirling the milk and sulphuric acid at a high rate of speed the fat will be separated quickly, as well as effectively. Dr. S. M. Babcock, of the University of Wisconsin, in 1890, was the first to furnish a practical means of using these facts. This method, called the Babcock Test, was given to the world as a free scientific discovery and is now in general use for determining the percentage of butter fat in milk. (It is interesting to note that the Legislature of Wisconsin in 1899 presented Dr. Babcock with a large gold medal recognizing "the great value to the state and to the whole world of the invention and discovery.")

APPARATUS.

The apparatus used in making the test is as follows:

a. Milk Pipette (capacity 17.6 c.c.).
b. Babcock Milk Test Bottles.
c. Acid Measure (capacity 17.5 c.c.).
d. A Small Dipper for Taking Sample.
e. A Pair of Dividers.
f. A Centrifugal Machine to Whirl the Bottles.
g. A Water Bath to Maintain Correct Reading Temperature.
h. Thermometer.
j. Pint Fruit Jar.
k. Acid Testing Hydrometer.

GETTING AN ACCURATE SAMPLE.

After the cow's milk has been thoroughly mixed by being poured from one vessel to another three or four times, the sample is taken either with a small dipper or a regular sampling tube or "milk thief." An accurate sample cannot be taken with an ordinary drinking or tea cup. The accuracy and value of the test depend largely on the care exercised in taking the sample. When we bear in mind, first, that the first part of the cow's milk is very poor in butter fat and the last part or strippings very rich in fat; second, that the percentage of butter fat in the morning's and night's milk frequently varies, it is self evident that a composite sample consisting of a number of small samples from different milkings gives a more accurate estimate of the cow's test. A representative sample is the first and most important item and, as a sample from a single milking will not give an average or representative test, it must be taken from a number of both morning and night milkings. The several small samples which go to make up a composite sample should be proportional in quantity; that is, if a cow gave 18 pounds in the morning and 12 pounds in the evening milking, the sample from the morning milking should be one and one-half times as large as the sample taken from the evening milking.

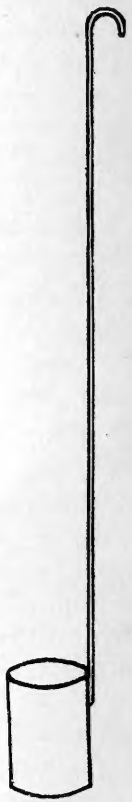


FIG. 2
Dipper for taking samples

PRESERVING SAMPLES.

In order to keep samples of milk any length of time some preservative such as corrosive sublimate must be added and the milk must be kept in air tight bottles (an ordinary pint fruit jar is excellent), and if the weather is very warm the jars of milk samples must be stored in a cool place. (Corrosive sublimate is sold in tablet form by druggists.) If the milk samples become sour and contain lumps of curd add a knife point of soda lye; shake and let it stand until the curd is thoroughly dissolved. When this is done the sulphuric acid should be added a little at a time as the chemical action is violent.

PERFORMING THE TEST.

Uniform Temperature.—The milk to be tested and the acid to be used should have a uniform temperature of from 60 to 70 degrees,

Fahr. If either the acid or the milk to be tested are much higher than 70 degrees the fat column will be dark and contain charred matter and thus spoil the accuracy of the test.

Mixing the Sample.—The sample to be tested must be thoroughly mixed by shaking vigorously and by pouring from one vessel to another.

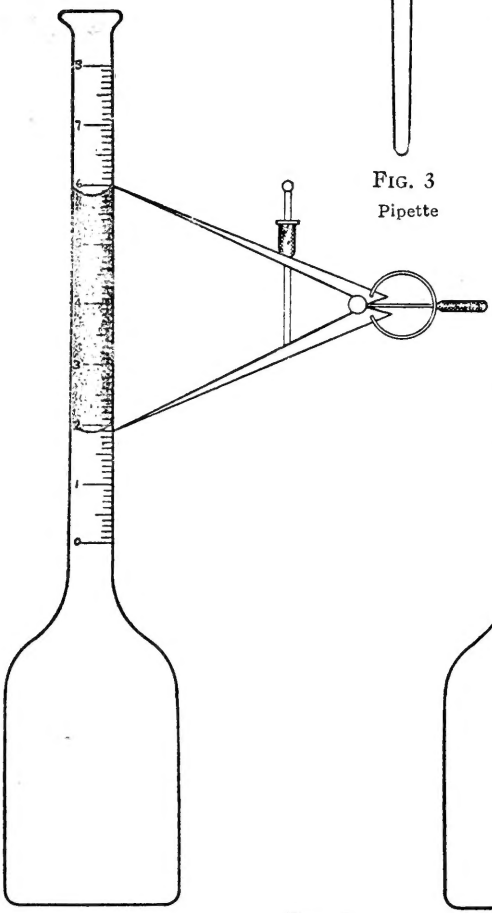
If the sample is a composite sample of milk delivered each day it is very essential that the jar of milk is shaken each time before a new sample is added and particularly so afterward, so as to be sure that the new sample is incorporated with the old ones. In order to obtain a homogeneous mixture it is sometimes necessary to warm composite samples to 85 degrees, Fahr., or even as high as 110 degrees if necessary by placing the jar in a water bath of the desired temperature, but it is absolutely necessary to reduce this temperature again to 60 or 70 degrees, Fahr., before drawing the sample into the pipette if a correct test is to be made.

If any cream adheres to the inside of the jar it is due to neglect of proper shaking each day or storage in a warm place or an uncleanly jar, and under no circumstances may this cream be taken off of the inside of the jar with a test tube brush because this cream will simply adhere to the bristles of the brush and a low test will result.

Measuring the Milk.—The instrument used to measure the milk for the test is called a pipette. There are two kinds of pipettes in common use, the "up-to-date" and the common pipette. (See illustrations.) The common pipette is just as accurate as the "up-to-date" pipette, if properly handled; and is less cumbersome, and if many samples are to be tested it is the quicker method of taking the sample. It has only one mark on the neck and when filled to this mark (see Fig. 3) holds 17.6 cubic centimeters of milk.

Place the narrow tip of the pipette into the milk while it is still in motion and with the mouth suck the air out until the milk rises in the pipette above the mark on the neck. Quickly place the index finger over the upper end of the pipette before the milk runs below the mark. By cautiously releasing the finger, the column of milk can be lowered until it is level with the mark on the stem of the pipette. Be sure to hold the mark on the pipette on a level with the eye so as to be able to see when the milk is on a level with the mark. (If a portion of the milk containing preservative should be drawn into the mouth, spit it out and rinse the mouth with clean water.) **(Corrosive sublimate is very poisonous.)**

FIG. 3
Pipette



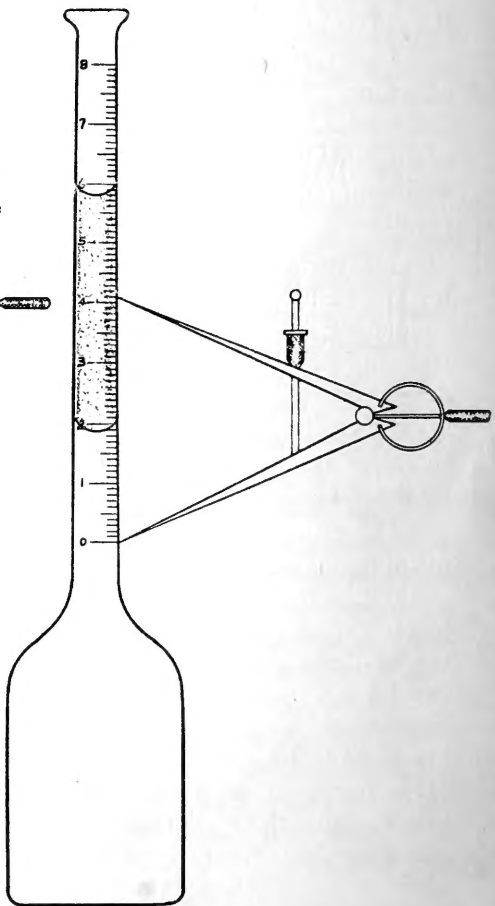


FIG. 4

The dividers in the first position for reading the test

The dividers in the second position

TRANSFERRING THE MILK INTO THE TEST BOTTLES.

First Method.—Insert the lower stem of the pipette into the neck of the test bottle, release the index finger and allow the milk to run into the bottle. (Do not lose any of the milk sample in the process of mixing, measuring, or transferring, for the Babcock test is essentially a quantitative analysis and any loss will affect its accuracy.) (See Fig. 5.)

FIG. 5
Another method of emptying Pipette into Test Bottle

Second Method.—Empty the sample into the test bottle by inserting the tip of the pipette into the mouth of the test bottle, the mouth of the test bottle and the pipette being slanted in opposite directions, as shown in figure. (See Fig. 7.)

Release the index finger and allow the milk to run slowly into the bottle in such a way as to permit the air to escape from the bottle without causing the milk to bubble out. In either case blow the last drop of milk out of the pipette before removing it from the test bottle.

Adding the Acid.—Fill the acid measure to the mark with sulphuric acid testing 1.82 or 1.83 specific gravity at 60 degrees Fahr. Pour the acid into the test bottle, holding the latter in an inclined position so that the acid will flow down the sides of the test bottle and not drop through the body of the milk in the bottle, the bottle being revolved so as to wash down all adhering particles of milk that may cling to the neck of the bottle. Charring of the milk and spilling of the acid will then be avoided. The acid will flow beneath the milk because it is heavier than the milk. Acid will eat holes in the flesh or clothing wherever spilled on them and should be washed off with water to which has been added ammonia water.

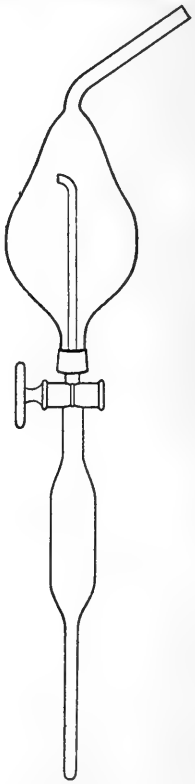


FIG. 6

The acid is added to destroy all the milk solids except the fat. In this process great heat will be produced, but this is advantageous since the fat must be kept in a liquid condition in order to perform the test properly. The best acid is colorless and should never contain any

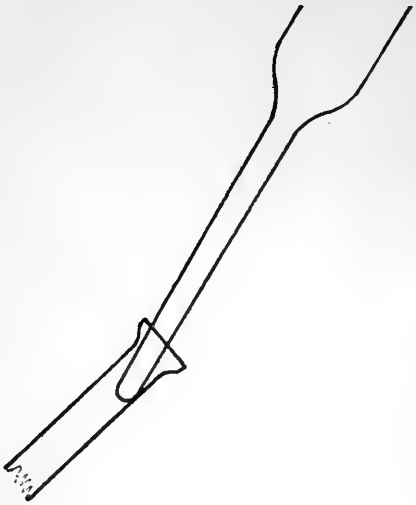


FIG. 7
Emptying Pipette into Test Bottles

undissolved material, as this is likely to rise with the fat and affect the reading. Glass stoppers must be used instead of ordinary corks on the acid bottles.

If the acid has been properly added there will be distinct layers of acid and milk in the test bottle without any black layer of partially mixed acid and milk between.

MIXING THE ACID AND THE MILK.

Mix the acid and the milk by shaking the bottle with a gentle rotary motion so that the acid will act equally on all parts of the milk. (See Fig. 9.) The mixture will now be of a dark brown color, with no undissolved particles remaining. It is well to mix the contents of the bottle for at least half a minute after all the milk has apparently been dissolved by the acid. During the filling and mixing, point the neck of the bottle away from the face, so that no drop of acid may be thrown into the eyes, as the mixing of the acid with the milk is often violent and may cause a drop to spurt out of the test bottle.

WHIRLING IN THE CENTRIFUGAL MACHINE.

The test bottles with the acid and milk properly mixed are now placed in the centrifugal machine, arranging the bottles in pairs at opposite sides of the center so that they will balance when rotated. An uneven number of bottles cannot be whirled. Whirl 5 minutes at the proper speed, which is as follows:

Diam. of Tester.	Rotations per min.
14	875 to 925
16	825 to 875
18	775 to 825
20	725 to 775

Stop the machine and add soft water at a temperature of 170 degrees Fahr. until the fat rises to the neck of the bottle. All water added must be soft as the use of hard water may cause bubbles on the top of the fat column. Rewhirl at the proper speed for 2 minutes and add soft water at a temperature of 170

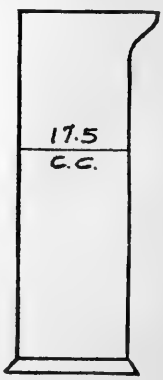


FIG. 8
Acid Measure

degrees Fahr. until the fat column rises to the 6 or 7 per cent. mark. (For 8 per cent. bottles.) Rewhirl at the proper speed for one minute and temper the bottles.

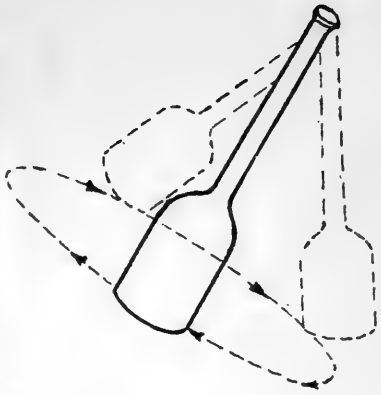


FIG. 9
Proper Motion for a Test Bottle while Mixing Milk and Acid

TEMPERING THE TESTS.

Since butter fat expands and contracts rapidly with changes in temperature it is necessary to keep the fat column at a constant temperature of 120 to 140 degrees Fahr. by placing them in a water bath of that temperature so that the water stands above the fat column in the necks of the bottles.

READING THE TESTS.

Milk tests are read from the extreme bottom to the extreme top of the fat column. In reading the tests hold the bottle perpendicular and on a level with the eye. Place one point of the dividers at the lower end of the fat column and the other point at the top of the fat column. Then lower the dividers until the lower point is on the zero mark of the test bottle; the upper point will indicate the per cent. of fat. Care must be taken to hold the dividers rigid while lowering. (See Figs. 4 and 10.)

COMMON CAUSES OF POOR TESTS.

1. Insufficient mixing of milk and acid, which may cause either a burned test or leave some of the curd undissolved.

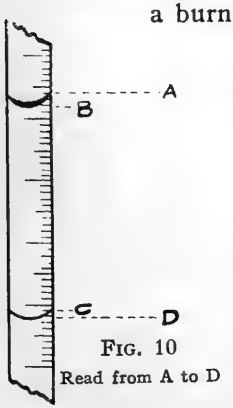


FIG. 10
Read from A to D

2. Too much or too little acid, the former giving a dark fat column containing charred matter and the latter a very light one with some undissolved curd at the bottom of the fat column.

3. Too strong or too weak acid, the former leaving a dark fat column while the latter will give a very light colored fat and some undissolved curd.

4. Too high temperature of either acid or milk or both. The result will always be a dark fat column containing charred matter. Try to have the acid and milk between 60 degrees Fahr. and 70 degrees Fahr.

5. Running the tester at too low a speed generally results in too low a test.

6. Hard water, which is apt to give a white foam on top of fat column.

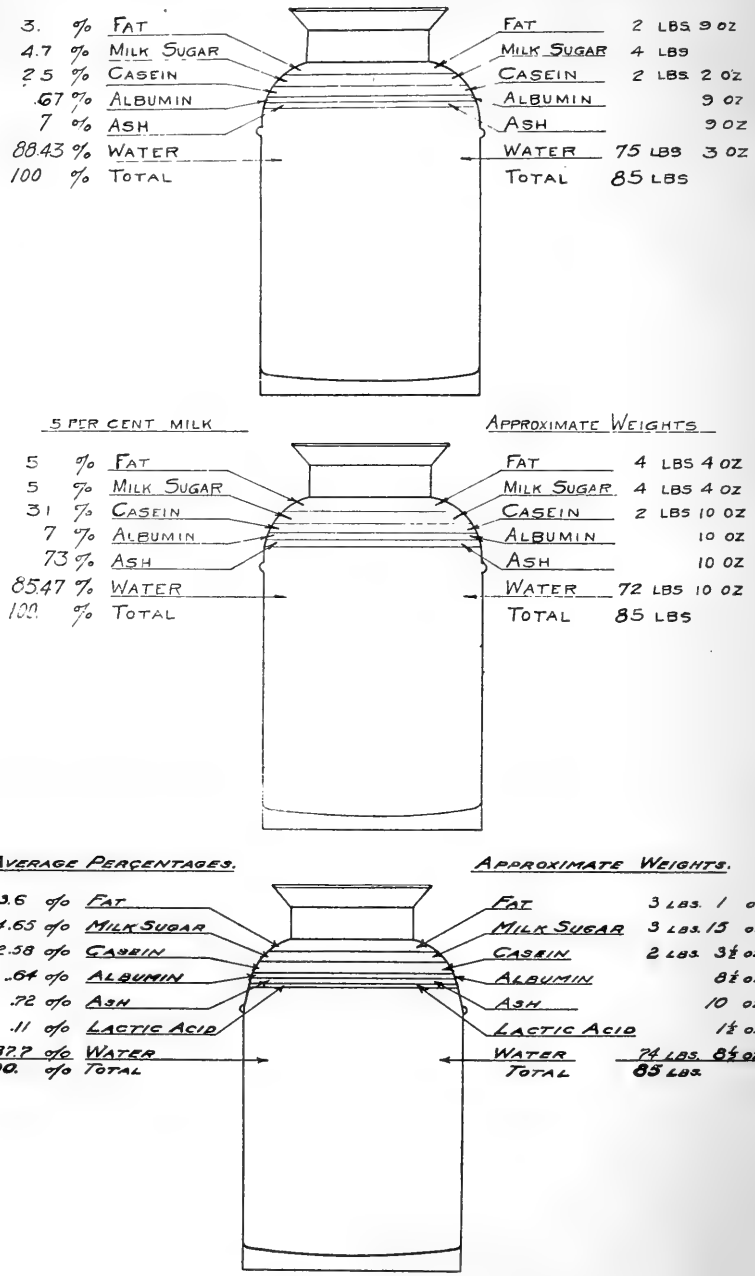
7. Inaccuracy in reading of fat column.

APPENDIX

CAUSES OF VARIATIONS IN THE BUTTER FAT TEST

CHART SHOWING VARIATIONS IN COMPOSITION OF

40 QUART CAN **MILK** 85 POUNDS



VARIATIONS OF FAT IN MILK.

The percentage of fat in normal milk varies a great deal; however, the fat content very seldom falls below 2.8 per cent, or above 7.2 per cent. The fat content of milk from a whole herd of cows varies only within comparatively narrow limits during the year, seldom exceeding .5 or .6 of a per cent. The chief factors which may cause the fat content to vary are:

1. The breed.
2. The individuality.
3. The age.
4. The time between milkings.
5. The manner of milking.
6. Whether the milk is fore or after milk.
7. Length of time since cow has freshened.
8. Condition of cow.
9. Excessive heat or cold.
10. Annoyance of flies, fleas, etc.
11. Any harsh language or ill treatment.
12. Chasing by dogs.
13. Poor ventilation.
14. Grooming.
15. Shedding.

VARIATIONS OF FAT IN MILK.

The chief factors which may cause the fat content to vary are:

1. **Breed.** The greatest difference in the test is noticed in animals of different breeds. Jerseys and Guernseys are comparatively high testers, while Holsteins are low testers.

2. **The Individuality.** There are undoubtedly cows of each breed which are much better testers than others of the same breed. Although the Holsteins as a whole are comparatively low testers, nevertheless there are individuals of the Holstein breed which are much better testers than many of the Jersey breed.

3. **The Age of the Cow.** Young heifers will nearly always produce milk testing a higher per cent. of fat during their first lactation period than during succeeding lactation periods, other conditions, of course, being the same.

4. **The Time Between Milkings.** Usually the time between milkings varies, the longer period being between evening and morning milkings. On account of this difference of time as well as from other causes the test for the morning's milk will vary from the test for the evening's milk. Often the two will vary as much as .5 of a per cent. (Commonly called 5 points.)

5. **The Manner of Milking.** Each cow should be milked by the same person who is acquainted with the individuality of the cow, and more particularly by the person with whom the cow is acquainted. Some cows will not tolerate a strange milker, and all will show a change in the butter fat test if milked under strange conditions.

6. **Whether the Milk is Fore or After Milk.** The fore milk contains very little butter fat while the after milk is very rich in butter fat, often reaching 15 per cent. **It is, therefore, very essential that the cow is milked clean in order to get all of the butter fat.** The practice of letting the calf have the after milk is all right for the calf but hard on the butter fat test. Let the calf have the fore milk, which contains less butter fat. It is good dairy practice, however, to feed the milk while warm to the calves and not let them suck at all, thereby avoiding any udder trouble caused by the calf.

7. **Length of Time Since Cow Has Freshened.** A cow just freshened has a lower butter fat test than she will have when she is approaching the end of her lactation period, but if a cow has been fattened just before calving she will give a high testing milk for 3 or 4 weeks, when the test drops back again to normal conditions.

8. **Condition of the Cow.** The nervous temperament and general condition of a cow will temporarily affect the butter fat test, particularly tending to reduce it.

9. **Excessive Heat or Cold.** When the cow is annoyed by excessive heat or shivering from the cold the butter fat is invariably reduced.

10. **Annoyance of Flies and Fleas.** The worry and annoyance of flies and fleas also diminish not only the flow but the butter fat test.

11. **Harsh Language.** Ill treatment of any kind causes a cow to become nervous and causes a reduction of the butter fat if not of the flow.

12. **Chasing by Dogs.** It is convenient to have dogs or children bring the cows to the barn, but the nervous excitement through fear of the dogs is anything but conducive to a large flow or a maximum test of butter fat.

13. **Poor Ventilation.** Cows breathing impure air are soon affected by a general sluggish disposition. An active cow gives the maximum flow and test and anything which detracts from the general active condition of a cow reduces both flow and test.

14. **Grooming.** Experiments have conclusively determined that a cow responds to grooming to a greater extent than any other thing. Just as a horse requires less feed, goes faster, and is in better condition when carefully groomed than when neglected, so a cow more than repays for the use of a comb and brush. It seems more than reasonable that a cow which is put in stanchions must be groomed, because she cannot groom herself as she could out in the open.

15. **Shedding.** Just as a hen ceases laying eggs during her molting period so a cow is affected to a slight extent when she is shedding. Part of the energy which formerly went to milk production goes to hair production, and naturally a slight decrease can be expected.

REFERENCES

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"Modern Methods of Testing Milk and Milk Products."

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Very valuable suggestions from the following bulletins were freely used:

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Bulletin 202—Colorado.
Bulletin 337—Cornell.
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Extension Bulletin 25—Nebraska.
Reading Course Lesson 118—Cornell.

Circular 27—Wisconsin.
Circular 37—Missouri.
Circular 41—Missouri.
Circular 64—Missouri.
Circular 174—Illinois.
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Circular 32—Iowa.