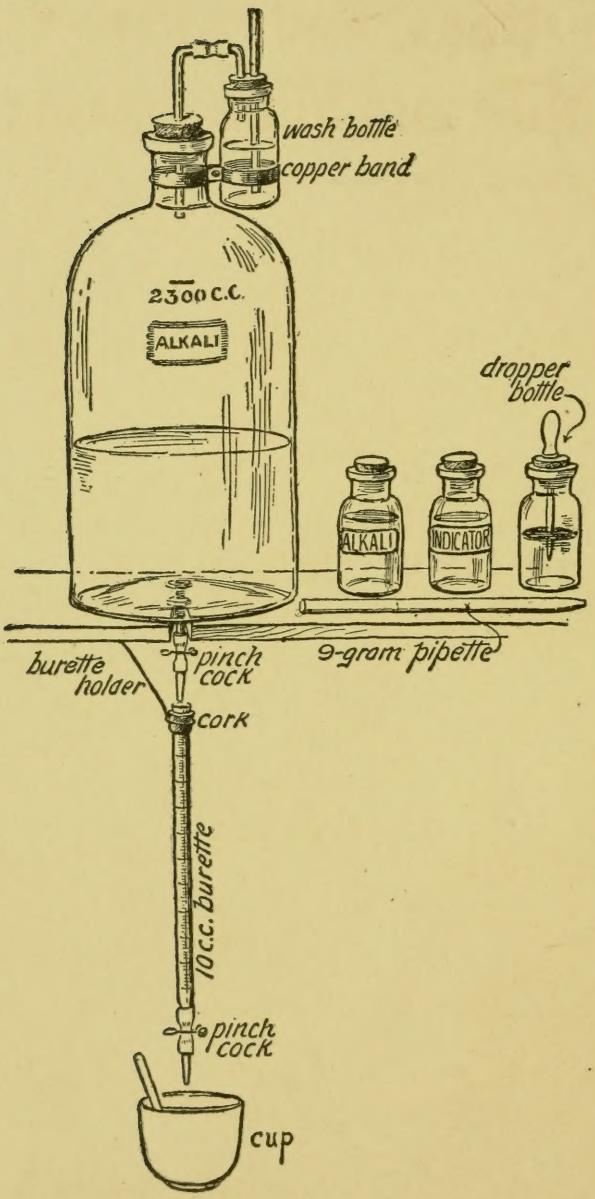
QUESTIONS AND ANSWERS ON MILK AND MILK-TESTING

CHAS. A. PUBLOW & HUGH C. TROY



THE PUBLOW ACID TEST

Questions and Answers on Milk and Milk-Testing

By

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PREFACE

Anyone who has had experience in teaching short-course students in dairying realizes the difficulty most of these students have in taking notes and in preparing for examinations. Many of these men and boys are good cheese and butter makers, but through lack of preliminary education they are unable to successfully place on paper the knowledge they really possess.

It is for these men more particularly that the authors have prepared this little book.

All up-to-date dairy literature has been freely consulted with the hope of making these question compends of the greatest service. Many new facts that have never appeared in any dairy books have been added and written in simple language. The special work on adulterations should be of considerable value to dairy instructors and to those who wish to prepare for civil service examinations for state positions in dairy work.

It is the intention of the authors to keep this book strictly up to date, and they will be grateful to all readers who may suggest any corrections or improvements that might be made to further the usefulness of the book.

CHAS. A. PUBLOW
HUGH C. TROY

September, 1909

Questions and Answers on Milk and Milk-Testing

What is the average composition of cow's milk?

Water	87.0%
Fat	4.0%
Sugar	5.0%
Casein	2.6%
Albumin	.7%
Ash	.7%
	100.0%

How does the composition of cow's milk compare with the composition of human milk?

Human milk contains more sugar, less casein and albumin and less ash. König gives the following composition of human milk:

Water	87.41%
Fat	3.78%
Sugar	6.21%
Casein and albumin	2.29%
Ash	.31%
	100.00%

The specific gravity of human milk is lower than cow's milk, being about 1.027.

How does the natural water in milk differ from other water?

Well water, spring water, and water from other sources varies considerably in composition. So does the composition of water in milk. But, ordinarily speaking, water in milk is not different from other fresh water.

In what form does fat exist in milk?

In small round globules held in suspension and forming an emulsion with the other constituents. These globules vary in size from $\frac{1}{1200}$ to $\frac{1}{25000}$ of an inch in diameter.

What can be seen when milk is examined under a high-power microscope?

Small fat-globules floating around in the milk serum.

In what form does sugar exist in milk?

In solution.

What is the composition of milk sugar?

Carbon	42.10%
Hydrogen	6.72%
Oxygen	51.18%

In what form does ash exist in milk?

Part in suspension and part in solution.

What forms of mineral ash are found in milk?

Calcium, sodium, potassium, phosphorus, magnesium.

In what form does casein exist in milk?

In minute particles held in suspension.

In what form does albumin exist in milk?

Albumin is in solution.

How does the action of casein differ from that of albumin?

Casein is in suspension. It is precipitated by rennet and acids. It is not precipitated by heat.

Albumin is in solution. It is not precipitated by rennet and acids, but is precipitated by a heat of 180° F.

What is the composition of casein?

Carbon	53.00%
Oxygen	22.70%
Nitrogen	15.70%
Hydrogen	7.00%
Phosphorus ...	.85%
Sulphur	.75%
	100.00%

What are the melting points of the important fats?

Olein	41° F.
Palmatin	142° F.
Myristin	129° F.

These fats become oily when heated and solidify on cooling, some fats sooner than others.

What is the specific gravity of fat?

About .93.

Of what is milk fat formed?

Fatty acids and glycerin.

What fats are present in milk?

Volatile	Butyrin	3.85%
	Caproin	3.60%
	Caprylin	.55%
Non-volatile	Olein	35.00%
	Palmatin	25.70%
	Myristin	20.20%
	Laurin	7.40%
	Caprin	1.90%
	Stearin	1.80%
		100.00%

What is a volatile fat?

One composed of a soluble volatile fatty acid and glycerin.

What is a non-volatile fat?

One composed of an insoluble non-volatile fatty acid and glycerin.

What factors influence the size of fat-globules in milk?

1. Breed of the cow.
2. Individuality of the cow.
3. Character of the food.
4. Period of lactation.
5. Age of the cow.
6. Diseased conditions.
7. The part of the milk examined.

What is the theory of an envelope surrounding fat-globules?

Some chemists have been unable to find any such covering, but Storch says he has found it to exist. and that it is composed of 94 per cent water and 64 per cent proteids.

How is the acid in milk, cream starters, or buttermilk measured?

By an acidimeter.

Describe an acidimeter and the method of testing.

There are several tests for measuring acid, and sold on the market under different names, such as Publow's, Mann's, Farrington's, and Marshall's, but the principle is the same in all of them. An alkaline solution of known strength and an indicator called phenol-phthalein are the reagents used. The purpose of the indicator is to indicate the reaction of the milk or cream; that is, it shows whether the milk or cream is acid, alkaline, or neutral. The indicator has no color effect in an acid solution, but it turns an alkaline substance red. When the neutral point is reached, the faintly pink color is barely distinguishable.

To make the test: A known quantity of the milk or cream to be tested is placed in a white cup. To this a few drops of indicator are added. An alkaline solution of known strength is then allowed to run in, drop by drop, from a graduated burette until the milk or cream assumes a faintly pink color, which signifies that all the acid in the milk or cream has been neutralized by the alkali used. The amount of alkali used can be read on the

How can bacteria be killed?

Most bacteria can be killed by heating to a temperature of 212° F. Many forms are killed by lower temperature, but spores are not destroyed by boiling.

How can spores be killed?

By fractional sterilization, i. e., by first heating to boiling point, 212° F., then cooling to 90° F., allowing remaining spores to develop at this latter temperature into bacteria and heating again to 212° F. to kill these. This procedure may be repeated several times.

How can milk or cream be tested on the receiving platform?

1. For acidity by the use of an acidimeter.
2. For odors by sense of smell.
3. For flavors by sense of taste.
4. For insoluble dirt by eyesight and by allowing samples to stand a few minutes in small glass jars so that the dirt will settle to the bottom.
5. In cold weather flavors and odors can be detected more readily if milk and cream are warmed up by steam.
6. By the use of fermentation or Wisconsin curd test.
7. Milk can be tested for adulteration by the use of a lactometer.
8. Samples can be taken for composite bottles or for daily testing for fat.

What is the fermentation test?

Commonly called "Wisconsin curd test." Sam-

5. In cold weather flavors and odors can be detected more readily if milk and cream is warmed up by steam.

6. By the use of a fermentation test.

7. For adulteration by the use of a lactometer.

8. Samples can be taken for fat-testing in the Babcock test.

Where is milk secreted?

In the mammary glands of all mammals which suckle their young.

Describe a mammary gland system of a cow.

A cow possesses two mammary glands situated on either side of the median line of the body on the under and hind part, and each gland is divided into two parts, called lobes. Each gland is composed of glandular tissue, being constructed largely of blood vessels and epithelial cells. Each of the four lobes has a small duct opening through which milk is carried after secretion to the teat outlets.

Describe the udder of a cow.

The udder is the milk reservoir of the cow, and is situated between her hind legs on the posterior part of the abdomen. It varies in size and shape and also in structure. The udder is composed of glandular tissue such as fatty tissue, milk ducts and canals, secreting cells, arteries, veins, lymphatics, nerves, and connective tissue which binds all the other tissues together. The glands are supported from the abdomen by a heavy band of fibrous tissue which extends from the abdomen through the udder in the median line. The whole

mass, which is more or less grayish red in color, according to its varied structure, is covered on the outside by a heavy fold of skin which is covered with fine hair and has marked elasticity.

Internally the udder is divided into four quarters, the two quarters on the same side communicating with each other and each quarter being supplied with an outlet or teat.

At the upper end of each teat is a fairly large cavity called a milk cistern, each of which may hold as much as one-half pint. In these the milk collects after being secreted and carried from the glandular cells by a more or less complicated series of milk ducts and canals. At the lower end of each teat a circular muscle exists, which, when contracted, has the power of closing the lower opening and preventing the escape of milk.

Considerable muscular tissue exists in the udder, especially around the walls of milk ducts and their dividing points. These muscles are well supplied with nerves so that the animal can by her will power control to a considerable extent, for a short time, the evacuation of milk after it has been secreted by the small cells. She cannot, however, control the actual secreting process. The milk-producing power of an udder depends largely upon the amount of blood carried to and from it through the arteries and veins.

How and from what is milk secreted?

Milk is secreted from the blood while it passes through the smallest blood vessels in the udder called the capillaries and from the lymph while it passes through the lymphatics.

The water, albumin, casein, and ash all come directly from the blood stream being more or less changed as they pass through the very thin walls of the capillaries and by the action of the glandular cells. The sugar is formed from the blood. The fat is derived from the breaking down of the gland cells by a process of fatty degeneration and from the lymph stream. The amount of milk secreted depends upon the amount and composition of the blood and lymph carried to and from the udder in a given time and also upon the activity of cell construction and cell destruction in the mammary glands.

What is colostrum?

Colostrum, or beastings, is the first milk secreted by a cow after the birth of her calf.

What is the average composition of colostrum? (Konig.)

Water	74.6%
Fat	3.6%
Casein	4.0%
Albumin	13.6%
Sugar	2.7%
Ash	1.5%

The composition of colostrum varies in individual cows to such an extent that only an average composition can be given.

How does colostrum differ in composition from ordinary milk?

Colostrum contains less water, less fat, less sugar, more casein, more albumin, and more ash. It is higher

in color and strong in odor, and has a laxative effect upon the bowels of the calf. Varied amounts of blood and broken-down cells are usually present, and the viscosity is greater. The specific gravity is also higher and colostrum is unfit for human consumption. Examined under the microscope, large colostrum corpuscles can be seen.

By what tests can colostrum be detected?

1. By the use of a lactometer, which shows a very high specific gravity.
2. Boiling throws down a large amount of albumin.
3. Examined under the microscope, colostrum corpuscles can be seen.

What is the natural color of milk due to?

1. To lactochrome.
2. To the color of the milk fats, especially palmatin.

What is milk serum?

The serum of milk is that part which is left after all fat has been removed.

What factors influence the composition of milk?

1. Breed of the cow.
2. Individuality of the cow.
3. Period of lactation.
4. Time of milking.
5. Part of milk tested.
6. Health of the cow.
7. Food and water consumed by the cow.

What ferments are present in milk?

1. Organized (Bacteria).
2. Unorganized (Galactase).

What is the difference between an organized and an unorganized ferment?

An organized ferment is due to the action of bacteria and has the power of reproducing itself.

An unorganized ferment or enzyme is formed by the action of glandular tissue and has not the power of reproducing itself, although its action may not be destroyed after performing its function. As an example of this we have rennet, which does not lose its power after coagulating milk.

What are bacteria?

They are the lowest forms of microscopical plant life, and are composed of protoplasm.

What are spores?

A spore is the breeding cell of a bacterium. All bacteria do not form spores, many reproducing by a process known as "fission," the cell simply dividing into two or more parts or bacteria.

What are the three necessities for bacterial growth?

1. Suitable food.
2. Moisture.
3. A proper temperature.

What bacteria are commonly found in milk?

1. Those that sour milk, called lactic acid bacteria.

2. Those that produce gas and bad flavors in milk, called putrefactive bacteria.

3. Those that produce disease called pathogenic bacteria.

4. Specific bacteria, such as those producing blue milk, bitter milk, ropy milk, etc.

How do bacteria gain entrance to milk?

1. From the air. The purity of the air determines the number and character of the bacteria. The air in unclean stables contains many bacteria.

2. From dirt or dust. All dirt and all dust carry many bacteria, mostly of the putrefactive type.

3. From the hands, clothing, or body of persons that have or recently have had or are caring for persons who have contagious or infectious diseases.

4. From unclean utensils.

5. From infected water supply.

6. From diseased cows.

What effects do bacteria produce in milk?

1. Some forms sour milk.

2. Some forms produce gas in milk.

3. Some produce undesirable flavors.

4. Some cause sweet coagulation.

5. Some cause ropy milk.

6. Some cause bitter milk.

7. Some produce abnormal colors in milk.

8. Some carry disease and render milk unfit for consumption.

How is the bacterial content of milk controlled?

1. By absolute cleanliness in all things surrounding the production and handling of the milk.

This tends to prevent the entrance of bacteria into milk.

2. By keeping milk cold. This checks the growth of bacteria. The lower the temperature, the more their growth is prevented and the longer will milk keep sweet.

3. By high temperatures. High temperatures are used to destroy bacterial life in milk. This is the principle of pasteurization.

4. Preservatives are used to kill bacteria or to prevent their growth. The use of preservatives in milk is prevented by most pure food laws.

5. Electricity has been used to destroy bacteria in milk.

6. The use of carbonic acid gas is used to carbonate milk and prevent the growth of bacteria.

What methods are used to keep bacteria out of milk?

1. The health of the cows is considered. The tuberculin test is used to diagnose tuberculosis. Milk from diseased animals is not used.

2. Cows' udders, flanks, and legs are shorn of hair to make cleaning easy.

3. These parts are washed or wiped with a damp cloth before milking.

4. Stables are properly ventilated, made free from dust, whitewashed, or otherwise made sanitary by cleanly methods.

5. The health, clothing, hands, and person of the milkers are regulated in sanitary requirements.

6. Small-top milking pails are used.

7. Milk is strained or filtered in a clean place.

8. Cans, bottles, and all utensils are sterilized before use.

9. Milk is bottled to prevent the entrance of air and bacteria.

10. Milk is cooled to low temperature as soon as drawn, and kept cold to prevent bacterial growth.

How can bacteria in milk be destroyed?

1. By heating to a high temperature for a time. Some forms are killed in ten minutes at 140° F., while others require a much higher temperature for a longer period.

2. By electricity.

3. By the use of certain poisons which destroy bacterial life.

What diseases are carried in milk?

1. Typhoid fever.
2. Scarlet fever.
3. Diphtheria.
4. Tuberculosis.
5. Intestinal infections, such as the cholera of infants and dysentery in adults.

How do the germs of disease enter milk?

1. In dust laden with disease-producing bacteria.

2. From the body or clothing of milkers who have had or have been exposed to diseases that are contagious or infectious.

3. From infected water used in washing or rinsing cans or utensils.

4. From diseased cows, especially when the udder is diseased.

5. From the excreta of animals, which may enter milk in small particles carrying disease-producing bacteria.

What causes milk to sour?

The lactic acid bacteria change the milk sugar into lactic acid, which is sour and as soon as sufficient acid is formed the whole volume of milk becomes sour to the taste.

What are the causes of bad flavors in milk?

1. Bacteria, which may enter milk in any of the following ways:

(*a*) From dust.
(*b*) On dirt from the body of the cow.
(*c*) From the atmosphere.
(*d*) From hands, body, or clothing of persons handling milk.
(*e*) From dirty utensils.
(*f*) From impure water.
(*g*) From diseased cows.

2. Flavors absorbed when milk is exposed in places where strong-smelling substances, such as turnips and decayed vegetables, are kept.

3. From strong-smelling foods eaten by the cow.

4. Keeping milk at too warm a temperature. When milk is warm, bacteria present grow rapidly, and their action on the different constituents of milk produces bad flavors.

How should milk cans and utensils be washed?

They should be first rinsed with lukewarm

water, then washed with a brush and hot water containing some good washing powder. Then boiling water or steam should be used to sterilize. The utensils should then be placed in a clean place free from dust. It is a good plan to expose milk cans, etc., to the direct rays of the sun, which have the power of destroying bacteria.

What is pasteurization?

It is the heating of milk to at least 140° F. for at least ten minutes for the purpose of destroying bacteria. The milk is then usually cooled to a low temperature. The word is derived from Louis Pasteur, an eminent French scientist.

What is sterilization?

It is the heating of milk to at least 212° F. for the purpose of destroying both bacteria and spores.

How is milk usually pasteurized for commercial purposes?

1. By some form of pasteurizing machine in which steam is the heating agent.
2. By electricity.

What are some of the reliable pasteurizing machines on the market?

1. Simplex.
2. Miller-Tyson.
3. Farrington.
4. Wizard.
5. Reid.

How can buttermilk be prepared from skimmed milk?

Skimmed milk is heated to 165° F. for ten minutes and then cooled to 70° F., when about 5 per cent of a good culture of lactic acid is added. The milk should be softly coagulated in 12 hours. It is then churned for five minutes and the result is a fine quality of buttermilk.

How are the fancy acid milk drinks prepared?

By pasteurizing skimmed milk, then cooling and adding cultures of some acid-producing bacteria or yeasts. The milk is securely bottled to prevent outside contamination.

What is market milk?

Milk that is produced and marketed solely for its use as milk.

How is milk marketed?

Milk in its raw state is marketed in one of two ways. (1) In bulk form. (2) In bottles or sealed vessels.

Milk is sold under many descriptive and yet deceiving names, such as aerated, clarified, modified, pasteurized, standardized, etc. These words usually indicate some special treatment given to milk by the producer or dealer.

What is sanitary milk?

Milk that is produced under sanitary conditions.

What is aerated milk?

Milk that has been exposed to the air for the purpose of cooling it or allowing animal odors to pass

off. Many forms of aerating devices are used for this purpose, but aeration has many disadvantages and practically no advantages in the production of clean, sweet milk.

What is clarified milk?

Milk that has been run through a separator or centrifugal machine for the purpose of removing insoluble dirt. This process has few beneficial effects on milk. It is much better to keep dirt out of milk in the first place than try to remedy the evil later.

What is modified milk?

Milk that is modified for some special purpose, such as infant feeding, by the addition of such agents as lime water and barley water, or by the removal of part of the fat or casein.

What is electrified milk?

Milk that has been treated by a current of electricity for the purpose of destroying bacteria.

What is pasteurized milk?

Milk that has been heated to a high temperature (at least 140° F.) for a period of time for the purpose of destroying bacteria. The milk is usually cooled immediately to at least 50° F. in order to increase its keeping power. A great deal of the milk consumed in the larger cities is treated in this manner, as it is a necessary way for the present at least, of remedying, in part, defects in milk caused by carelessness.

What is carbonated milk?

Milk that has been treated with carbonic acid gas for the purpose of preserving it.

What is malted milk?

Milk that has been heated to a high temperature for the purpose of killing bacteria, partly condensed and then a small quantity of malt added.

What is peptonized milk?

Milk to which some pepsin has been added for the purpose of making milk more easily digestible. The pepsin may be added to whole milk, or the milk may first be partly condensed.

What is condensed milk?

Milk from which a large amount of water has been extracted by some process of evaporation. Sometimes cane sugar is added for making what is known as sweetened condensed milk.

What is the composition of unsweetened condensed milk? (Konig.)

Water	58.99%
Fat	12.42%
Casein and albumin.	11.92%
Milk sugar	14.49%
Ash	2.18%

What is the composition of sweetened condensed milk? (Konig.)

Water	25.61%
Fat	10.35%
Casein and albumin.	11.79%

Milk sugar	13.84%
Cane sugar	36.22%
Ash	2.19%

What is milk powder?

Milk that has been evaporated to dryness and then placed in a machine which reduces the dried milk to a finely powdered condition.

What is standardized milk?

Most states have a standard of quality to which milk must comply before being sold as whole milk. Some states have a law which requires that milk must contain at least 3.5 per cent fat and at least 12 per cent total solids. Some breeds of cows do not give milk that tests that high, so it is necessary to add some cream or take away some skim milk. This process is known as standardizing. At the same time, in some states, milk must comply with a law which says milk must not be adulterated.

How can the amount of milk or cream necessary for standardizing be determined?

This problem has been made easy by the use of a formula and square devised by R. A. Pearson, commissioner of agriculture in New York state. Draw a square and write at the two left-hand corners the percentages of fat in the milk and the cream or skim milk that is to be mixed with it. In the center write the percentage of fat desired. The difference between the figures in the center and the figures at the left are placed on the right-hand corners with which they stand in line. The figures at the two right-hand corners then represent the

proportions in which the milk and the cream or skimmed milk should be mixed.

The idea can, perhaps, be more easily understood by working out a problem such as the following:

How much 5 per cent milk must be added to 3.5 per cent milk to make 1,000 pounds of 4 per cent milk?

.5 $\frac{5}{15} \times 1000$ lbs.=333 lbs.

$\frac{1.0}{1.5}$ $\frac{1.0}{1.5} \times 1000$ lbs.=666 lbs.

The milk must be mixed .5 part of 5 per cent milk and 1. part of 3.5 per cent milk in every 1.5 parts. Therefore, as figured above we must mix 333 pounds of 5 per cent milk and 667 pounds of 3.5 per cent milk in order to make 1,000 pounds of 4 per cent milk.

Prof. Oscar Erf has also prepared a table to be used in standardizing milk and cream, but it is not necessary to give it here.

What means are commonly used to improve the milk supply of towns and cities?

This work usually is conducted under direction of the boards of health. In most places all persons delivering milk in towns and cities must comply with the requirements of a special law which states that all milk sold must be produced and handled in such a manner that it reaches the consumer in a clean, sanitary condition.

Inspectors are appointed to inspect the dairies and, if necessary, compel the farmer to improve his

dairy methods. Educational means are used as far as practicable, but if any man refuses to comply with the sanitary requirements the inspector reports him to the board of health, which usually cancels his license and prevents him selling milk until he fulfils the demands of the board.

For the convenience of both the farmer and the inspector, and to insure uniform inspections, a score card is used upon which most conditions can be reported.

The score card on pages 24 and 25 is the one lately devised by the official dairy instructors' association, and which is now most used in the United States.

What is meant by specific gravity?

It means the ratio existing between the weights of equal volumes of a substance and water at 4 degrees centigrade.

Why is the temperature of 4 degrees centigrade chosen?

Because water reaches its greatest density at that temperature.

What is the specific gravity of whole milk?

The average is about 1.032, but, in some cases, it may be as low as 1.029, or it may go as high as 1.034; that is, if a volume of water weighs 1,000, the same volume of average whole milk would weigh 1,032.

How would you calculate the weight of 40 quarts milk?

1 quart water weighs 946.4 grams.
1 quart milk weighs 946.4×1.032 grams.
453.6 grams=1 pound.
976.6848 grams=2.153 pounds.
1 quart milk weighs 2.153 pounds.
40 quarts milk weigh 2.53×40 pounds=86.12 pounds.

How does the weight of 40 quarts milk compare with the weight of 40 quarts water?

1 quart milk weighs 2.153 pounds.
1 quart water weighs 2.086 pounds.
40 quarts milk weigh 86.12 pounds.
40 quarts water weigh 83.44 pounds.
The weight of milk is 1.032 times as great as the same volume water.

What substances make up the milk serum?

Water	87.0%
Casein and albumin..	3.4%
Milk sugar	5.0%
Mineral matter	.7%

What is the specific gravity of melted milk fat?

Between the temperatures of 120° F. and 160° F. the specific gravity is .9; that is, when a definite volume of water weighs 1,000 the same volume of milk fat weighs 900.

What common proof have we that the specific gravity of milk fat and milk serum differs?

When milk remains quiet for a time, the globules of fat rise to the surface in the form of cream.

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF ANIMAL INDUSTRY,
DAIRY DIVISION.

SANITARY INSPECTION OF DAIRIES.

DAIRY SCORE CARD.

Adopted by the Official Dairy Instructors' Association.
(Subject to revision at future meetings.)

Owner or lessee of farm .....

P. O. address ..... State .....

Total number of cows ..... Number milking .....

Gallons of milk produced daily .....

Product is retailed by producer in .....

Sold at wholesale to .....

For milk supply of .....

Permit No. ..... Date of inspection ....., 190

REMARKS .....

(Signed) .....
Inspector.

D. D. 225—9-1-03—5,000

DETAILED SCORE.

EQUIPMENT.	SCORE. Perfect.	SCORE. Allowed.
COWS.		
Health	6	
Apparently in good health	1	
If tested with tuberculin once a year and no tuberculosis is found, or if tested once in six months and all reacting animals removed	5	
(If tested only once a year and reacting animals found and removed, 2.)		
Comfort	2	
Bedding	1	
Temperature of stable	1	
Food	2	
Water	2	
Clean	1	
Fresh	1	
Light: ¼ sq. ft. of glass per cow	4	
(Three sq. ft., 3; 2 sq. ft., 2; 1 sq. ft., 1. Deduct for uneven distribution.)		
Ventilation. Automatic system	3	
(Adjustable windows, 1.)		
Cubic feet of space for cow: 500 to 1,000 feet	3	
(Less than 500 feet, 2; less than 400 feet, 1; less than 300 feet, 0.)		
STABLES.		
Location of stable	2	
Well drained	1	
Free from contaminating surroundings	1	
Construction of stable	4	
Tight, sound floor and proper gutter	2	
Smooth, tight walls and ceiling	1	
Proper stall, tie, and manger	1	
UTENSILS		
Construction of utensils	1	
Water for cleaning	1	
(Clean, convenient, and abundant.)		
Small-top milking pail	3	
Facilities for hot water or steam	1	
Milk cooler	1	
Clean milking suits	1	
HANDLING THE MILK		
Location of milk room	2	
Free from contaminating surroundings	1	
Convenient	1	
Construction of milk room	2	
Floor, walls, and ceiling	1	
Light, ventilation, screens	1	
Total	40	

METHODS.	SCORE. Perfect.	SCORE. Allowed.
COWS AND STABLES.		
Cleanliness of cows	8	
Cleanliness of stables	6	
Floor	2	
Walls	1	
Ceiling and ledges	1	
Mangers and partitions	1	
Windows	1	
Stable air	6	
Barnyard clean and well drained	2	
Removal of manure daily to field or proper pit	2	
(To 50 feet from stable, 1.)		
UTENSILS AND MILKING.		
Care and cleanliness of utensils	8	
Thoroughly cleansed	5	
Inverted in pure air	3	
Cleanliness of milking	9	
Clean, dry hands	3	
Udders washed and dried	6	
(Udders cleaned with moist cloth, 4; cleaned with dry cloth at least 15 minutes before milking, 1.)		
HANDLING THE MILK.		
Cleanliness of attendants	1	
Milk removed immediately from stable	2	
Cleanliness of milk room	3	
Prompt cooling. (Cooled immediately after milking each cow)	2	
Efficient cooling; below 50° F.	5	
(51° to 55°, 4; 56° to 60°, 2.)		
Storage; below 50° F.	3	
(51° to 55°, 2; 56° to 60°, 1.)		
Transportation; iced	3	
(For jacket or wet blanket allow 2; dry blanket or covered wagon, 1.)		
Total	60	

Score for equipment ____ + Score for methods ____ = _____ **Final score.**

NOTE 1.—If any filthy condition is found, particularly dirty utensils, the total score shall be limited to 49.
NOTE 2.—If the water is exposed to dangerous contamination or there is evidence of the presence of a dangerous disease in animals or attendants, the score shall be 0.

How does the fat affect the specific gravity of milk?

The specific gravity of milk fat being only a little more than .9, it is lighter than the other constituents and tends to lower the specific gravity.

Why is it that milks, naturally rich in fat, have a higher specific gravity than milks naturally poor in fat?

Pure milks, rich in fat, contain larger percentages of solids not fat than do those of low fat content. Take, for example, samples of milk of the following composition:

	Fat	Solids not fat	Board of health lactometer reading
1....	3.9	8.6	108.
2....	4.9	9.1	111.

No. 2 contains 1 per cent more fat and .5 of 1 per cent more solids not fat than does No. 1. One per cent of fat lowers the lactometer reading practically 3 degrees, while .5 of 1 per cent of solids not fat raises the lactometer at least 6 degrees. Thus we have a final lactometer reading of 111 in the richer milk.

What is the specific gravity of the milk solids?

The solids of normal milk have a specific gravity between 1.25 and 1.34, the average being about 1.30.

What is the specific gravity of the solids not fat?

The solids not fat are made up of casein, albumin, sugar, and mineral matter, and have a specific gravity of about 1.50.

What is the specific gravity of milk protein?

It is held by some that the specific gravity of milk protein is about 1.34.

How does milk fresh from the cow differ in specific gravity from milk several hours old?

Fresh milk has a lower specific gravity, due in all probability to the gases in the fresh milk. For this reason milk should be several hours old when tested if accurate results are desired.

What is a lactometer?

It is a form of hydrometer made especially for taking the specific gravity of milk.

What two forms of lactometers are in common use?

The Quevenne lactometer and the New York board of health lactometer.

Describe a Quevenne lactometer.

It consists of a hollow, cylindrical body so weighted at one end that when floated in milk it takes an upright position. A stem is attached to the upper end of the body. The stem contains a scale so graduated and set that when the instrument is floated in the milk the specific gravity may be read at the upper surface of the liquid. The better class of instruments contain a thermometer, the bulb being melted in the lower end of the body and the scale appearing directly over the lactometer scale.

Describe the Quevenne lactometer scale.

The scale is graduated from 15 to 40, each graduation marking one lactometer degree, and figures denote the reading every five degrees. When the floating instrument comes to rest with the surface of the liquid on the 15 mark the liquid has a specific gravity of 1.015, and when it comes to rest in a liquid with the surface on the 40 mark the liquid has a specific gravity of 1.040. Hence to obtain the specific gravity place the figures 1.0 in front of the lactometer readings.

At what temperature should the lactometer reading be taken?

The lactometers are made to be used at 60° F.

If the milk is at a temperature above or below 60° F., can a correction be made on the Quevenne lactometer reading?

When the temperature of the milk is between 60° F. and 70° F., add .1 to the lactometer reading for each degree above 60. When the temperature of the milk is below 60 and above 50 subtract .1 from the lactometer reading for each degree below 60. This correction is only approximate and cannot be used for wider variations in temperature than those given above. The temperature of milk should be brought within those limits before taking the lactometer reading.

Describe the New York board of health lactometer.

It has the general appearance and form of, and is made like, the Quevenne lactometer, but the graduations on the scale are different.

Describe the graduations on the scale of a board of health lactometer.

The scale extends from zero to 120. The zero point is at the top of the stem at the mark to which the lactometer sinks in water at 60° F. When the instrument is floated in cleanly skimmed milk the surface of the liquid would be near the 120 mark; 100 marks the point below which the instrument is never expected to settle in pure milk. There are 60 divisions on the scale, each division equaling two lactometer degrees.

What is the temperature correction for the board of health lactometer?

Add .3 to the lactometer reading for each degree of temperature above 60° F., and subtract .3 for each degree below 60° F. If the temperature of the milk is more than 10 degrees from 60 degrees, bring it within those limits before taking the reading, as the correction cannot be used for greater variations in temperature.

Compare the scales on the board of health and Quevenne lactometers.

The zero point on each is the point to which the instruments sink when placed in water at 60° F. The 29 mark on the Quevenne scale corresponds to the 100 mark on the board of health scale, hence each board of health lactometer degree is .29 of a Quevenne lactometer degree, or the latter is 3.44+ times greater than the former.

How may one lactometer reading be converted to that of the other?

To convert the board of health lactometer reading to the Quevenne reading, multiply the board of health reading by .29; and to convert the Quevenne reading to board of health, divide the Quevenne reading by .29.

If a sample of milk read 108 on the board of health lactometer at 66° F., what would its specific gravity be at 60° F.?

In this problem the temperature correction may be made first, then convert to the Quevenne reading by multiplying by .29, and finally prefix the figures 1.0.

66—60=6. 6×.3=1.8.

108+1.8=109.8.

109.8×.29=31.84.

The specific gravity, therefore, is 1.03184.

Between what graduations on the board of health lactometer may normal milks vary?

Between 103 and 115 and in some few cases milk may read as low as 100 or as high as 118.

Between what graduations on the Quevenne lactometer may normal milks vary?

Between 30 and 34, but in rare cases the milk may read as low as 29 or as high as 35.

Upon what law of physics does the action of the lactometer depend?

It depends upon the fact that a solid body floating in a liquid displaces a weight of the liquid equaling the weight of the floating body.

How should the lactometer reading be made?

It may be conveniently made by placing the milk in a cylinder, 1½ inches in diameter and 10 inches high, then lowering the lactometer in the milk until it floats. Let the lactometer adjust itself for about half a minute before taking the reading. If more than half a minute elapses before taking the reading, cream may rise and affect the result.

How does the temperature affect the specific gravity of milk?

Heat causes milk to expand. A given volume of cold milk will occupy more space when warmed up. Hence, heat reduces the specific gravity of milk.

By making use of the differences in specific gravity of its constituents can one test milk accurately for its fat content without using a chemical?

No, because some of the milk serum will rise with the fat, even when great centrifugal force is used to separate them, and the quantity of serum remaining with the fat will vary with milks of different quality.

What is a lactoscope, and how is it used?

It is an instrument for determining approximately the amount of fat in milk. It may be of some value when used in connection with the lactometer. The instrument consists of a graduated glass barrel with a tightly fitting stopper at the bottom. The stopper carries a white glass cylinder with black lines thereon. The cylinder extends up into the barrel a short distance. Four c. c. of milk are run into the barrel and water added with thorough mixing,

until the operator can distinguish the dark lines on the cylinder through the liquid. The graduations at the surface of the liquid in the barrel then indicate the percentage of fat in the milk.

What is a pioscope?

It is an instrument for determining roughly the quantity of fat in milk or whether the milk is of a high or low grade. It consists of a shallow receptacle with a rim raised slightly above a surrounding hard, black disk. Into the receptacle a few drops of milk are placed and covered with a circular cover-glass having variously tinted segments. The milk spreads out in a thin layer and its color as seen against the dark background may be matched by one of the tinted glass segments. The different tinted segments represent different grades of milk.

Describe in brief the Babcock test.

The test was perfected by Professor Babcock and given to the public in 1890. It depends upon sulphuric acid to free the fat-globules and upon centrifugal force to bring the fat together so that it may be measured. A definite quantity of the milk is placed in a glass bottle, sulphuric acid is added, the mixture well shaken, then placed in a centrifugal machine and whirled to bring the fat together. Water is then added to the bottles until the fat rises in the graduated part of the neck, where the volume of the melted fat can be read directly in percentage.

Describe the Babcock test machine.

Various styles are found on the market made to be run by hand, steam, or electrical power. They vary in size from the small two- or four-bottle tester, convenient to carry from place to place, to the larger machines accommodating 24 or more bottles, and suitable for factory work. They usually consist of an inclosing frame or covering and a horizontal revolving disk attached to a shaft in the center. Swinging pockets for holding test bottles are attached to the rim of the disk in such a way that they hold the bottles upright when the disk is quiet, but in a horizontal position, with the opening toward the center, when the disk is revolving. In steam machines a turbine is attached, either to the upper or lower end of the shaft. These machines are very satisfactory for factory work where steam power can be used, while the hand machines are more suitable for testing small dairies or where a few tests are made occasionally.

How can one determine the number of revolutions the disk makes for one revolution of the handle in a hand machine?

Mark a point on the rim of the disk and turn the handle slowly once around, counting the number of times the point on the disk reaches the point at which it started.

How many revolutions per minute should the disk in a Babcock machine make in order to do good work?

The number of revolutions depends upon the diameter of the circle in which the bottles whirl.

Farrington and Woll have figured out that the number of revolutions should be those given in the following table:

Diameter of the disk	Revolutions per minute
10″	1,074
12″	980
14″	909
16″	848
18″	800
20″	759
22″	724
24″	693

What conveniences should be attached to a Babcock tester run by steam?

1. Steam gauge.
2. Steam brake for stopping the disk.
3. Speed indicator.
4. Water heater and means of filling bottles quickly.

What points should be observed in selecting a machine?

1. The machine should be durable and safe to operate.
2. Should run smoothly.
3. Should have a capacity corresponding to the work and carry an even number of bottles.
4. Pockets should always swing free so the bottles may come to an upright position when the disk comes to rest.
5. The bottles should be protected against the entrance of oil from the machine.

6. There should be means of ventilation for temperature control.

7. Bearings should be so placed that heat from the steam will not affect them.

8. Means should be provided for using a heavy oil where the bearings may become heated from the steam.

9. The bearings should be protected so that acid cannot come in contact with them when bottles break in the machine.

How should the milk test bottles be constructed?

1. The graduated portion of the neck should be accurate.

2. The bottles should hold about 50 c. c. and be made of tough glass of even thickness throughout, and strong enough to stand pressure and sudden changes of temperature.

3. The top of the body of the bottle should slant toward its center at an angle not greater than 40 degrees, so that all the fat may rise in the neck.

4. The bottom should be perfectly flat, so that all points will be supported evenly while being whirled in the machine.

5. The diameter of the neck should be neither too large nor too small, and should be the same as other bottles in the set used.

6. The top should be strong, well annealed, and flaring, to readily admit the pipette and assist in preventing loss when milk is introduced.

How is the scale on the neck of the bottle divided?

Each cubic centimeter of space is divided into five equal parts, each part equaling 1 per cent.

The latter are divided into five equal parts, each part equaling two-tenths of 1 per cent. With a little practice one may read accurately to one-tenth of 1 per cent.

Why does the scale on the neck of the bottle show the per cent of fat?

Because the graduated portion holds two cubic centimeters and the specific gravity of melted butter at 140° F. is .9. One c. c. weighs 0.9 of a gram and 2 c. c. weigh 1.8 grams, which is 10 per cent of 18 grams, the weight of milk taken.

What can be done to make the scale easy to read?

Rub it over with a soft pencil, burnt cork or a paste made by dissolving asphalt in turpentine.

How may the test bottles be marked for identification?

1. A ground space may be made on the body or neck of the bottle upon which numbers can be placed with a lead pencil.

2. Copper bands with stamped numbers can surround the neck of the bottle.

Describe a skim-milk test bottle.

This has two necks, one having a larger bore. Substances are introduced through the larger bore, and the smaller one, which is graduated, is used to collect the fat.

When placing the bottle in a centrifuge, the large neck should be turned toward the center of the machine.

What points in the construction of skim-milk bottles need special attention?

1. The scale should be correct and the bore large enough to admit milk or water freely.

2. The glass should be tough and strong enough to stand the pressure of whirling and the changes of temperature.

3. The top of the body should slant gradually toward the center, with no uneven places where fat might collect.

4. The large neck should enter the body at the base of the graduated tube and extend down through the center of the body almost to the bottom so that the acid will run under the milk and not char part of it before they can be properly mixed.

How closely can percentage be read on a skim-milk bottle?

Some bottles are graduated to measure .01 per cent while others read only as low as .05 per cent. On either form one can distinguish easily variations of .01 per cent.

Describe the different forms of Babcock cream test bottles.

1. Bottles with necks having a graduated capacity from zero to 30 or 40 per cent and a body so large that an 18-gram quantity may be used, the graduations reading to 1 per cent or five-tenths of 1 per cent.

2. Bulb-neck bottles of the same capacity as those above, but graduations reading to two-tenths of 1 per cent.

3. Bottles with capacity of 9 grams of cream and 9 c. c. of acid and a scale showing the percentage direct as high as 50 per cent.

4. Bottles with scales showing the percentage direct, to 50 per cent for 9-gram samples, and with bodies large enough so the cream may be diluted with water before adding the acid.

What advantages has a 9-gram cream bottle over other forms when the graduations on it show the percentage direct and its body holds about 50 c. c.?

1. Accuracy is increased, because a neck of smaller diameter and a finer scale may be used.

2. In reading the percentage direct any error is not doubled as occurs with the ordinary bottle when the sample is divided and the observed reading is doubled.

3. The smaller diameter of the neck reduces the error due to the difficulty of making proper allowance for the space occupied by the meniscus.

4. The size of the body allows the addition of 9 c. c. of water before adding the usual amount of acid, thus diluting the cream and preventing the acid from attacking the fat, as often occurs when equal volumes of rich cream and acid are mixed.

5. Richer cream may be tested, as the bottle may be graduated to give readings of 50 per cent.

How does the graduated portion of the neck in cream test bottles vary?

1. It varies in capacity, some bottles being graduated from zero to 50 per cent and others from zero to 30 per cent, etc.

2. It varies in per cent represented by the smallest divisions on the scale, which, in some bottles, are equal to 1 per cent, while in others they represent two-tenths of 1 per cent.

3. When a cream bottle is made with a bulb in the neck, the bulb usually represents 10 per cent, and is not otherwise graduated. The graduated portion above and below the bulb may be graduated as fine as two-tenths of 1 per cent.

What should be the capacity of cream test bottles?

The part below the neck should hold about 50 c. c., even though only 9 grams of cream are used in making the test.

How should the pipette be made?

1. Of tough glass with a strong annealed tip, and having an opening large enough to allow the milk to run out freely, yet not so large as to flood the neck of the test bottle.

2. The tube below the body should be about 4 inches long, and small enough to enter the neck of the bottle.

3. The space between the upper end of the pipette and the mark on the stem should be large enough so that after filling the pipette, one will have time to place the finger over the end before the milk runs below the mark.

How much milk should the pipette deliver?

It should deliver 18 grams of milk, or 17.44 c. c. $18 \div 1.032$ (sp. g. milk) $= 17.44$.

Why is the pipette marked 17.6?

Because it holds 17.6 c. c. Some milk is always left in the pipette, and this makes up the difference between 17.6 and 17.44.

What is meant by "calibrating" Babcock glassware?

It means the determination of the correctness of the graduations on the glassware.

By what methods can glassware be calibrated?

1. By the use of a plunger
2. By the use of a scale.
3. By the use of mercury.
4. By the use of an accurate pipette or burette.

Describe how milk-testing bottles may be calibrated by the use of a plunger.

The bottle is filled to the zero mark with some liquid such as water. Any drops of the liquid clinging to the walls of the neck above the zero mark should be removed with a strip of blotting paper. A brass plunger divided into two sections connected by a small wire, and each section equaling 1 c. c., is inserted in the neck of the bottle until the first section is completely submerged. The level of the liquid should then be exactly on the 5 per cent mark.

The plunger is then inserted farther into the bottle until the second section is submerged, when the surface of the liquid should reach the 10 per cent mark, if the bottle is correctly graduated. Bottles showing a variation of more than .2 per cent should be rejected.

How may cream-testing bottles be calibrated by the use of a plunger?

In the same manner as milk-testing bottles, excepting that a larger plunger is used. Each c. c. of space occupied by the plunger equals 5 per cent in the neck of the bottle.

What precautions should be taken in calibrating with a plunger?

1. Have the surface of the liquid level with the zero mark.

2. Remove any liquid adhering to the walls of the neck above zero mark.

3. The plunger should be dry before inserting.

4. There should be no air bubbles in the neck during calibration.

5. The temperature of the plunger should be the same as that of the liquid.

6. While calibrating do not allow heat from the hand to cause the liquid to expand.

How may testing bottles be calibrated by use of scales?

Fill the bottle to the zero mark with water and balance it on the scales. Add 1 gram of water. The surface of the liquid should then be exactly on the 5 per cent mark. On addition of another gram of water the surface should be level with the 10 per cent mark. Each two-tenths of a gram equals 1 per cent in the neck of the bottle. By this means any part of the neck of milk or cream bottles may be calibrated.

How may mercury be used to calibrate the testing bottles?

From a correctly graduated burette run 2 c. c. of mercury into the clean and dry test bottle. Then push a close-fitting stopper into the neck of the bottle level with the highest graduation. When the bottle is turned upside down the mercury should just fill the graduated portion of the neck. The mercury may be transferred from one bottle to another without loss by connecting the necks with a piece of closely fitting rubber tubing. In this manner several bottles may be tested with the same mercury.

How may the bottles be calibrated by use of a burette?

Fill the bottles exactly to the zero mark with a liquid. Then run in from the burette liquid to fill the graduated part of the neck. Each two-tenths of a c. c. taken from the burette should equal 1 per cent in the neck of the bottle. By this means each per cent of space in the neck may be readily calibrated.

How may the pipette be calibrated?

By closing the tip and running in 17.6 c. c. of liquid from a correctly graduated burette. The surface of the liquid should then be level with the mark on the stem. Or one may accurately balance a small vessel on scales. Place 18 grams on the opposite side of the scales. Then fill the pipette to the mark with milk having a Quevenne lactometer reading of 32. Allow the milk to run into the vessel, blowing the drop from the tip of the

pipette into the vessel. The quantity of milk delivered from the pipette should just balance the 18 grams placed on the other side of the scales.

How may the acid measure be calibrated?

1. By running into the measure from a graduated burette 17.5 c. c. water. The upper surface should then just reach the 17.5 mark.

2. Balance the measure on a scale and place 17.5 grams weight on the opposite side. Then fill the measure to the mark with water. The weight of the water should just balance the 17.5 gram weight.

What forms of acid measures are used?

1. A glass cylinder holding 17.5 c. c.

2. The Swedish acid bottle and 17.5 c. c. pipette combined.

What acid is used in the Babcock test?

Sulphuric acid, with a specific gravity of 1.82 to 1.83 and strong enough to produce a light yellow color in fat.

What substances other than acids are sometimes used?

Solvents like ether, alcohol, or petroleum spirits may be used to bring the fat into solution and separate it from the milk serum.

What are the principal reasons for using an acid in testing fat?

1. To destroy the sugar and films of casein that entangle the fat.

2. To destroy the viscosity of the fluid and to free the fat-globules.

What should be the color of the sulphuric acid?

It should be clear and almost colorless. Organic matter falling into the acid becomes charred and darkens the color. This does not spoil the usefulness of the acid, unless undissolved particles are present which would spoil readings.

What are the advantages of using sulphuric acid in the Babcock test?

1. It quickly dissolves milk solids other than fat and destroys viscosity, thus liberating the fat.

2. In combining with the water and solids of the serum, it generates much heat, which melts the fat.

3. It increases the specific gravity of the liquid surrounding the fat, thus making it easy for the fat to separate.

4. It is comparatively cheap and easy to obtain.

5. It is non-volatile when hot, and so produces no injurious gases.

How may one determine if the acid is of proper strength?

By using a form of hydrometer called an acid-meter. This instrument, when placed in the acid, should come to rest with the surface of the liquid between the graduations 1.82 and 1.83. A little experience will enable one to judge by the appearance of the fat at the end of the test if the acid is of proper strength.

If the acid is too strong, how may it be corrected?

1. By adding the acid to a small quantity of water.
2. By using less acid in testing.
3. By cooling both milk and acid before mixing.

If the acid is too weak, how may it be corrected?

1. By using a larger quantity.
2. By warming both acid and milk before testing.
3. If much too weak, the acid should be discarded.

Will the acid weaken with age?

Not if kept in tightly stoppered containers. It will, however, absorb water from the air and become weaker if left in open vessels.

Why is it that acid which was of the proper strength in winter will be apparently too strong in summer?

During summer the acid, milk and apparatus has a higher temperature, so the acid appears stronger. The remedy is to cool both acid and milk.

What kind of stoppers should be used in bottles containing sulphuric acid?

Glass stoppers only. The acid and its fumes destroy both cork and rubber.

How may red spots, produced on clothing by acid, be removed?

If the acid has not been in contact with clothing

too long, an application of dilute ammonia will remove the spots.

What precautions are necessary in handling sulphuric acid?

1. All vessels containing acid should be plainly marked.
2. It should be kept in tightly stoppered glass bottles.
3. Tables, sinks, drains, and pipes which come in contact with acid should be covered with lead.
4. In mixing, always add the acid to the other liquid—not the liquid to the acid.
5. In measuring or pouring, keep acid away from the face.
6. If a bottle breaks in the centrifuge, flush the machine with plenty of cold water.
7. If acid is spilled it should be cleaned up with a cloth immediately and the spot covered with a strong alkali.
8. If acid is spilled on the flesh, wash it off immediately with cold water and apply lime water or some dilute alkali.
9. Refuse material containing acid should be disposed of where it will not come in contact with valuable vegetation, animals, or persons.

What kinds of milk may be tested with the Babcock test?

All kinds from which a fair sample may be secured.

Can a person who has had no chemical training use a Babcock test?

Yes, anyone capable of following directions and who will exercise proper care may learn in a short time to use the test correctly.

How should the milk sample be taken on the weighing stand?

The sample is best secured by using a sampling tube, because it takes the same proportionate amount from each quantity sampled and takes a uniform column from the upper surface to the bottom of the milk. When the quantity and quality of the milk varies but little from day to day, it may be sampled with a small dipper with good results. A graduated glass tube can be used by taking 10 or 20 c. c. for each 100 pounds of milk, or 1 c. c. for each pound when sampling milk from individual cows. The sample of a patron's milk at a receiving station should be taken immediately after it has been poured into the weighing can. It should be transferred at once to the proper container. Several forms of milk samplers or milk thieves are on the market and most of them give good results with milk.

How much milk should be taken for a sample?

Enough so that in case of an accident occurring during the first test you would still have some left to make another. About 6 ounces is sufficient.

When the value of a patron's milk is determined by its fat content, how often should the milk be sampled?

Each quantity weighed in should be sampled and tested either by itself or by a composite.

What is a composite sample, and why are such samples used?

A composite sample is the quantity of milk secured by mixing together samples of different days' milk. They are taken in order to determine in one test the average amount of fat in the milk received for a definite period at different times.

How should composite samples be kept?

In airtight bottles in a cool, dark place convenient to the place where milk is weighed and sampled. They should be kept under lock and key, and sufficient preservative should be added to keep the milk in good condition until tested.

What points should be considered when securing containers for composite samples?

1. They should be durable and easy to clean.
2. Stoppers should fit tightly and be easily removed.
3. They should have large necks so that milk may be added to or taken from them quickly and without loss.
4. They should be of convenient size and properly marked to identify each sample.

What preservatives are used in composite samples?

1. Corrosive sublimate or mercuric chlorid.
2. Bichromate of potash.
3. Formaldehyde.

What are the advantages of corrosive sublimate?

1. It is an effective preservative.

2. Small quantities are used.
3. Can be secured in a convenient tablet form.

What are the disadvantages of corrosive sublimate?

1. It is a deadly poison.
2. In excess it hardens milk casein so that the acid does not dissolve it so readily.

How much preservative should be used?

Enough to keep milk or cream sweet until tested. Usually one to two tablets of mercuric chlorid will preserve one-half pint for two weeks. Of formalin one-half c. c. should preserve the same sample for two weeks. If bichromate of potash is used, add enough of it to give the milk a lemon-yellow color. About 15 grains is usually sufficient to keep a pint of milk for two weeks.

What are the advantages of formalin?

1. It is a good antiseptic.
2. It is in liquid form.
3. It is not a violent poison.

What are the disadvantages of formalin?

It tends to harden casein so that sulphuric acid does not readily dissolve it.

What are the qualities of potassium bichromate as a preservative?

1. It is inexpensive.
2. It is not a violent poison.
3. It colors the milk yellow and the quantity necessary to add can be determined by the depth of color of the solution.

The disadvantages are:

1. Excessive amounts are sometimes necessary in hot weather to preserve the milk.

2. Then it interferes with the acid dissolving the casein and a clear test is not secured.

3. High acidity of the milk reduces its preservative qualities.

4. Samples containing it may form a tough skin over the surface, especially in the light, more readily than with other preservatives.

How should the composite bottle be handled while adding milk?

Each time a bottle is taken from its place it should be held in an upright position until it has been quickly whirled in a circle. This mixes the fat with the remainder of the sample and prevents it from becoming attached to the sides of the bottle and drying. The next portion of milk may then be added and the sample shaken once more to distribute the fresh milk and the preservative evenly.

How often should composite samples be shaken, and how long may they be kept before testing?

Composite samples should be shaken once a day whether fresh milk is added or not. They should be tested every ten days or two weeks at the longest.

What special precautions are necessary in the testing of composite samples?

1. Be certain that any cream that may have become attached to the sides of the container is removed.

2. That all lumps or dried particles are dissolved and evenly distributed. This may be accomplished by warming the sample not higher than 105° to 110° F. and mixing. Then, if necessary, pass the cream through a fine sieve and mix before drawing the sample.

3. Take extra care to have all casein dissolved, as the presence of a preservative makes it less soluble.

What special points should be observed in testing cream?

1. The bottles in a set should all be of the same make.

2. They should be graduated to two-tenths of 1 per cent.

3. The bottles should have a plain distinguishing mark.

4. Secure a representative sample of the cream.

5. Use the same quantity of cream in each test.

6. Make tests in duplicate.

7. Weigh out samples on balances accurate to $\frac{1}{10}$ of a gram.

8. Do not destroy the sample until the results of the test are written down.

9. The volume of acid used should be the same as the volume of substance to which it is added.

10. Shake the bottles for some time after the casein is all dissolved.

11. Be sure the temperature of the fat is right at the time of reading.

12. Read the scale from the bottom of the fat column to the bottom of the meniscus.

13. Write down results immediately upon reading them.

14. If tests are not satisfactory in every particular, make them over. Honest results cannot be accomplished without accurate work.

How would you proceed to secure a proper sample of the milk for testing?

Where possible, mix the milk by pouring it from one vessel to another two or three times. If the cream has risen, care should be taken so that it is all reincorporated with the milk and evenly distributed. When it is impossible to pour the milk, use some appropriate instrument to thoroughly stir it, then while the fat is evenly distributed the samples must be taken, using a 17.6 c. c. pipette or 18 grams weighed on a scale.

How is the milk transferred to the test bottle?

By sucking it up into a pipette, quickly placing the forefinger over the end and allowing the milk to escape until its surface is level with the 17.6 c. c. mark on the stem. Then place the tip of the pipette a short distance into the neck while holding the bottle in a slanting position, so that its opening will not be entirely closed. By reducing the pressure with the forefinger the milk will run down the side of the neck and will not be blown out by escaping air. The drop remaining in the tip of the pipette should be blown into the test bottle.

How much acid is used, and how is it added?

A volume of sulphuric acid equal to the volume of milk tested is used. It is usually measured in a

small cylinder and transferred to the test bottle, allowing it to run down the side of the neck. Any adhering milk will be washed down if the bottle is rotated during the process. The acid should run under the milk until all is added. Then mix it quickly and thoroughly by holding the bottle in a slanting position and whirling the body in a circle while the top remains stationary.

When should the test bottles be whirled in the centrifuge?

Immediately upon mixing with the acid and while still hot. The test would not be spoiled if the bottles stood for a time before whirling, but it would be necessary to heat them to the proper temperature before beginning the operation.

How long and how often should the bottles be whirled?

The first whirling should last five minutes. Water is then added until the fat rises to the base of the neck. Then whirl for two minutes to wash the fat free from any undissolved substance. Hot water is again added until the bottom of the fat column is some distance above the zero mark. Then the final whirling is given for one minute.

How should the water be added?

Hot, with some form of pointed tube or pipette and allowed to fall directly on the fat to wash out undissolved particles. In the Mitchell-Walker test the water enters the bottles from a revolving water centrifuge while the machine is running.

What character of water should be used?

Soft water should be used when possible, but any ordinary good water will serve. One or two cubic centimeters of sulphuric acid added to the water used for the final filling will aid materially in giving a clear fat column, especially if the water is hard.

Why does the mixture of milk and acid become hot?

Sulphuric acid, combining with the water of milk, generates most of the heat. Some heat is developed by the action of the acid on the milk solids.

Why does the mixture turn dark?

The acid burns or oxidizes the milk solids, which contain carbon. The darkening process is similar to burnt wood, becoming dark when burned in air.

If the acid does not completely dissolve the casein in composite samples, how may the difficulty be overcome?

1. Have the acid and milk at a slightly higher temperature than usual at the time of mixing.
2. Use a larger amount of acid than ordinarily.
3. Shake the samples for a longer time than usual before placing them in the machines.

If the temperature of the fat is not right when through whirling, how may it be corrected?

1. If too hot, allow the bottles to stand a short time at room temperature.
2. If too cold, place the bottles in hot water.

3. All bottles should be placed in water of about 140° F. after removal from the machine if accurate and uniform results are desired.

How should the fat column appear when the test is completed?

It should be a light golden yellow throughout its length, with no specks or particles of undissolved matter near its base, and the liquid in the neck under the fat should be as transparent as the air above it, thus giving the fat the appearance of resting in the neck without support.

If the column of fat is darkened and contains black specks or black substance at its base what does it indicate?

It indicates one or more of the following conditions:

1. That the acid is too strong.
2. That the temperature of the milk or acid, or both, was too high.
3. That too much acid was used.
4. Improper mixing.

If the fat column is light in color, containing white specks or a clouded or white mass at the base, what does it indicate?

It indicates one or more of the following conditions:

1. That the acid is too weak.
2. That not enough acid was used.
3. That the milk and acid were too cold at the time of mixing.

If the fat has the proper color, but contains undissolved substance, what is the trouble?

It usually indicates insufficient mixing before placing in the centrifuge, but may possibly be due to improper water.

When should the per cent of fat be read?

Immediately upon completing the whirling, if the temperature of the fat is correct. The fat solidifies at about 100° F., and the temperature of the bottles should be considerably above that during the whirling.

How should the fat be measured?

By holding the fat column on a level with the eye and counting the divisions on the scale in that part of the neck occupied by the fat. Give credit for all the fat between the lowest and highest points on the fat column. Each division on the scale usually represents two-tenths of 1 per cent, but some bottles are now made upon which each division represents one-tenth of 1 per cent.

How may an instrument assist in measuring the fat?

By using some form of dividers and fixing the points at the extreme ends of the fat column. Then change the position until one point rests on the zero mark and the other on the scale above. The intervening space will have a length equal to that of the fat column and the per cent may be read directly.

Does all the fat rise in the neck of the bottle?

It has been found by comparing the results with

chemical analysis that about one-tenth of 1 per cent will not rise. When credit is given for the curved spaces that are not occupied by fat at the ends of the fat column, the results agree closely with chemical analysis.

How should skim milk be tested for fat?

In the same manner as whole milk, excepting that a special double-neck test bottle is used. About 1 to 1.5 c. c. extra amount of sulphuric acid is used, and the machine should whirl the bottles about a minute longer than usual. The fat percentage is read on the graduated part of the small neck.

How are buttermilk and whey tested for fat?

In the same manner as skim milk, excepting that it is not necessary to use more than 17.5 c. c. of sulphuric acid.

How should cream be tested for fat?

By weighing accurately a representative sample of the cream into a special cream test bottle, and then following the method used for testing whole milk.

How may a proper sample of cream be secured?

By pouring the cream from one vessel to another and having all lumps of dried cream thoroughly distributed and reincorporated. Then take the sample with a sampling tube, or, if one cannot be secured, use a dipper to transfer the cream to the sample bottle.

How may cream that is frozen be sampled?

Samples should not be taken until the cream is thawed and properly mixed.

Can sour cream be accurately sampled?

If it were absolutely necessary, approximate results might be secured by adding solid caustic soda to neutralize the acid and dissolve the casein, then take the sample after properly mixing.

What quantity of cream should be used in the test bottle?

That depends upon the capacity of the graduated neck and the richness of the cream. If the neck were graduated from zero to 30 per cent and the cream tested more than 30 per cent, less than 18 grams of cream would have to be used, and the per cent would be as much greater than the observed reading as the quantity taken was smaller than 18 grams.

How should cream in sample bottles be prepared for testing?

If the cream is in a fluid condition it may be mixed by pouring from one bottle to another several times, but if it is lumpy and thick, or has dried on the bottle, it should be warmed to 105° F., then properly mixed and sampled. To destroy lumps, pass it through a fine sieve, then mix and test. Heating above 105° F. is liable to separate some fat from the rest of the cream.

Why should the cream sample be weighed rather than measured?

1. Because with every change in the per cent of fat in cream there is a change in the specific gravity, so that a pipette that would hold the proper amount of cream of one quality would not hold the right amount of cream of another quality.

2. Cream is viscous and a variable amount remains in the pipette.

3. Air bubbles become incorporated during the mixing and gases from fermentation also cause bubbles which are retained in the cream on account of its viscosity, so that in measuring out such cream too small a quantity would be secured.

How should the per cent of fat be read?

By counting the graduations between the bottom of the fat column and the bottom of the meniscus at the upper surface of the fat.

Why do we not read to the top of the meniscus as in the case of milk bottles?

Because the diameter of the neck is greater and the space occupied by the meniscus is larger in cream bottles and is altogether too large a quantity to allow for the fat that does not rise.

When the whole of the fat column has the clouded appearance and color of muddy water, how may it be corrected?

1. It may be corrected by shaking the mixture of cream and acid for several minutes before whirling, in the meantime keeping the bottles hot. After the whirling is completed the condition of the test may be improved by allowing the fat to solidify.

Then reheat and whirl for a short time in the machine before reading.

2. In filling after first whirling use a mixture of equal volumes of sulphuric acid and water.

How often should the test bottles be washed?

The bottles should be thoroughly washed after each test, not only to remove the fat, but also to remove other foreign matter that would become too firmly attached to remove if left in while making several tests.

How should the test bottles be washed?

1. Shake them well when emptying.
2. Rinse with hot water containing some good washing powder.
3. Rinse thoroughly with plain hot water.

What can be done to hasten the washing process?

Special devices which enable the operator to handle several bottles at a time may be used. These consist of racks for holding bottles securely, trays for submerging large numbers of bottles in the washing solutions, and sprays for rinsing.

How may unsweetened condensed milk be tested by the Babcock method?

Thoroughly mix the sample and weigh 20 grams into a bottle or flask. Add 40 c. c. of water and shake until thoroughly mixed. Test in duplicate, weighing 18 grams into a milk test bottle and proceed as in testing milk. Multiply the reading of the fat by three to obtain the per cent.

How may the fat in sweetened condensed milk be determined by the Babcock test?

The method devised by Farrington is practically as follows:

Dissolve 40 grams of the condensed milk in 100 c. c. of water. Measure into a milk-testing bottle a Babcock pipette full to the mark of this solution. Add about 3 c. c. of the sulphuric acid used in testing milk and shake the mixture vigorously. The coagulated casein incloses the fat and they are thrown down together by whirling in the machine at a high speed and a temperature of 200° F. The liquid containing much of the sugar is carefully poured off. Ten c. c. of water is then added and the mass of curd is broken up and thoroughly shaken with the water to remove more sugar; 3 c. c. of acid is again added and the bottle whirled as before. The liquid is again poured off. The test is now completed by adding 10 c. c. of water and 17.5 c. c. of sulphuric acid and proceeding as in the fat test for milk. Multiply the fat reading by 3.2 to obtain the per cent.

C. B. Cochran proposes the following method for fat in sweetened condensed milk:

"Weigh out 25 grams of the sample, dissolve in water and make up to 100 c. c. Transfer 6 c. c. to a double tube milk flask provided with a small bore tube graduated to give percentage of fat for 5 c. c. of milk. Add 4 c. c. of ether and 4 c. c. acetic acid (80 per cent or more absolute acid). Acetic acid of this strength will dissolve the curd, but has no effect on the sugar. Place the flask in a vessel of warm water and heat until the ether is expelled. A layer of milk fat will now be seen floating on a

clear and colorless liquid. Fill the flask with hot water, thus raising the fat into the graduated tube. The percentage of fat can now be read. The sample is then whirled in a centrifugal machine and another reading made. Multiply the reading by four."

Why is it impossible to test sweetened condensed milk by the Babcock method in the ordinary way?

Because the acid chars the cane sugar and does not dissolve all of it. The blackened and undissolved sugar rises with the fat and makes it impossible to secure a clear reading.

How may the fat content of dried milk or milk powder be determined?

Van Slyke has had quite satisfactory results by combining the Gottlieb and Babcock methods as follows:

"Dissolve 10 grams of milk powder in 100 c. c. of water. Take 10 c. c. of this solution in a 100 c. c. glass cylinder. Add 1 c. c. of strong ammonia and shake until thoroughly mixed with the solution. Then add the following reagents, one after the other, shaking vigorously after each addition before adding the next material: 10 c. c. of 92 per cent alcohol, 25 c. c. of washed ether, and 25 c. c. of gasoline or, better, petroleum ether (boiling point below 80° C.). The cylinder is closed with a tightly fitting, moistened cork stopper. The contents of the cylinder, after thorough shaking, are poured into a 200 c. c. beaker, the cylinder being rinsed with a little gasoline, and this added to the

beaker. The beaker is then placed on a steam bath or in boiling water, and kept there until the ether, alcohol, and gasoline are completely evaporated. The remaining liquid is then poured into a milk-testing bottle and the beaker is rinsed with a little ether, which is also added to the test bottle. The test bottle is then placed in boiling water for a few minutes to evaporate the ether. After cooling the contents of the test bottle to about 70° F., add 17.5 c. c. of sulphuric acid and complete the operation as in the case of milk by the Babcock test. The reading is multiplied by 18. In some cases, as in dried skim milk, it is desirable to make the original solution more concentrated by having 20 or more grams in 100 c. c. of solution.

"The following precautions must be observed in using this method:

"1. The milk powder solution must be made uniform before sampling.

"2. The shaking of the mixture must be vigorous and thorough after the addition of each of the reagents used.

"3. The evaporation of the reagents added must be complete, otherwise the final results are apt to be too high.

"4. The evaporation must not be carried so far as to cause any appearance of solid particles in the liquid. When this happens, the fat column contains darkened material, which makes the results uncertain.

"This method is applicable to skim milk, whey, and buttermilk, which usually do not give high enough results by the Babcock method."

Can butter be tested for fat by the Babcock method?

Yes; but not with as much accuracy as many other dairy products.

How is butter tested for its fat content?

1. By the ether method. Evaporate a known weight (2 to 3 grams) to dryness in a flat-bottom dish. Then wash the total contents of the dish upon a weighed filter paper, using about 50 c. c. of ether or naphtha. Then wash free from fat the residue on the filter paper with ether or naphtha. The filter is then dried at 100° C. to constant weight and weighed. The percentage fat is determined by the difference between the weight of butter and the weight of fat.

2. By Babcock test. Weigh 4 grams of butter into a cream bottle, adding enough water to make 18 grams in the bottle. Add 17.5 c. c. of sulphuric acid and after thoroughly mixing whirl in the centrifuge for five minutes. Add hot water at 200° F. to raise the fat in the graduated neck of the bottle. Whirl again for two minutes, then multiply the reading on the bottle by 4.5.

How should the scale be read in testing butter?

The same as in testing cream, giving credit for that part of the scale between the bottom of the fat column and the bottom of the meniscus. The temperature of the fat should be between 130° and 140° F.

What is meant by an aliquot part of a quantity?

It is the part that results from dividing a quantity by a whole number, which leaves no remainder.

Example: 20 is an aliquot of 100, resulting from the division of 100 by 5.

How may a representative sample of cheese be secured for the fat test?

Where possible, cut a wedge-shaped piece reaching from the circumference to the center of the cheese. When this is impossible, three plugs should be taken with a trier reaching halfway or all the way through the cheese, one near the circumference, one halfway to the center, and the third near the center. In either case the sample secured may be made fine by passing through a meat grinder or by cutting to very fine pieces. Thoroughly mix before taking the sample.

How much cheese is taken for the test and how is the per cent calculated?

Six grams gives good results, but 4.5 grams or 9 grams may be used. In either case, when the ordinary cream test bottle is used, to obtain the per cent of fat divide 18 by the weight of cheese taken and multiply the observed reading by the quotient. Example: If 6 grams of cheese were taken and the observed reading was 12, what was the per cent of fat?

$18 \div 6 = 3$.

$12 \times 3 = 36 =$ per cent of fat.

How is the fat in cheese determined by the Babcock test?

Weigh into a cream bottle the quantity to be used. If 6 grams are taken, add 12 c. c. of hot water to make 18 grams in the bottle, shake thor-

oughly, let stand about five minutes and while it is still quite warm add 17.5 c. c. of sulphuric acid. It is well to add half the above amount of acid first, shake thoroughly and then add the remainder and shake until the casein is all dissolved. The test is then completed in the same manner as for cream or butter.

If the casein in the fat test of cheese does not readily dissolve, how may it be brought into solution?

1. Let the cheese soak in the hot water in the test bottle for 10 or 15 minutes before adding the acid.

2. Have the mixture of cheese and water quite hot at the time of adding the acid and add the acid in small quantities, shaking between each addition.

3. Add an excess of acid.

Describe the Gerber fat test for milk.

The Gerber test depends upon the same principles for separating the fat that are used in the Babcock fat test. Eleven c. c. of milk, 10 c. c. of sulphuric acid (specific gravity 1.825) and 1 c. c. of amyl alcohol are used. The cork is inserted and the contents of the bottle thoroughly mixed. The cork should then be forced in until the liquid extends well into the narrow graduated neck at the opposite end of the bottle. The mixture is centrifuged five minutes, the bottles resting on the corked ends meanwhile. The fat column is then read the same way as in the Babcock test.

How is the Russian Babcock fat test bottle constructed?

The bottle consists of a cylinder and a graduated neck. The cylinder is about an inch in diameter and 5½ inches long, having a constriction a short distance above the surface of the liquid, when the milk and acid are mixed. The funnel-shaped lower end of the graduated neck rests on the shelf formed by the constriction, while the upper end extends a short distance out of the cylinder.

How is the Russian Babcock fat test operated?

The neck is removed from the bottle while adding the milk. It is replaced before whirling the bottle in the centrifuge. After whirling for five minutes at the speed proper for the size of the machine (usually 1,200 revolutions per minute), hot water is added. The special construction of the machine and the bottle make it possible to add hot water without stopping the whirling. The bottle is whirled for one minute after adding the full amount of water. The per cent of fat is read as in the regular Babcock fat test.

What are the features peculiar to the Russian Babcock fat test?

1. A specially constructed test bottle.

2. The use of one-half the amount of milk and acid taken in the Babcock fat test.

3. A specially constructed centrifuge, enabling the operator to add hot water without stopping the machine.

Give four formulas used in determining the solids not fat in milk.

1 $\frac{L + .7\,F}{3.8} =$ solids not fat.

2 $\frac{L}{4} + .2\,F + .14 =$ solids not fat.

3 $\frac{L}{4} + .2\,F =$ solids not fat.

4 $\frac{L + F}{4} =$ solids not fat.

In each of these formulas L=lactometer reading and F=fat.

How do the results secured by the different formulas compare?

No. 1 gives the highest results, while No. 3 gives the lowest. Nos. 2 and 4 give about the same results excepting on rich milks, when No. 4 gives results that are nearly as high as those secured with formula No. 1.

With what class of milks does each of the formulas give best results?

Formula No. 1 gives results that correspond fairly well with chemical analysis for milks having a Quevenne lactometer reading of 33 or more and having more than 4.5 per cent of fat. Formula No. 2 gives its best results in milks having a Quevenne reading between 31 and 33 and a fat content between 3.7 and 4.5 per cent.

Formula No. 3 gives best results on all milks having a Quevenne reading of less than 31 and a fat content of 3.7 per cent or less.

Formula No. 4 will give good results with milk of average quality or richer milks.

How may the per cent of total solids be determined?

By adding the fat as determined by the Babcock test to the solids not fat, as determined by the application of the formula.

Is there a formula for determining the per cent of protein in milk?

The following formula has been developed by G. A. Olsen:

$$\frac{TS - A}{3.694} = P$$

In this formula T S=total solids, A=ash, and P=protein. The ash is to be called .75 in all cases.

Below what percentage do the solids not fat of pure milk rarely go?

The solids not fat of pure milk are usually more than 8.5 per cent, and they very rarely go below 8.4 per cent.

How does the addition of water to milk affect the specific gravity?

Since the specific gravity of water is less than the specific gravity of milk, the addition of water to milk reduces the specific gravity of the mixture.

How does the skimming of milk affect its specific gravity?

Since the specific gravity of the fat is less than the specific gravity of the other constituents of milk, skimming increases the specific gravity.

Why is it that the specific gravity is not a sure indication that milk has been neither skimmed nor watered?

Because a sample of milk might be skimmed, or partly skimmed, and then just water enough added to reduce the specific gravity to what it was before the skimming took place; thus there would be no change in the specific gravity, although the milk was adulterated.

What is the approximate proportion of fat to solids not fat in normal pure milks?

One cannot state the proportion definitely, since the relative quantity of the constituents in milks from different cows, breeds, etc., varies. In general it will be found that the pure milk of a herd contains fat and solids not fat closely approaching some one of the proportions given in the following table:

Fat	Solids not fat	Total solids
3.00	8.40	11.40
3.25	8.47	11.72
3.50	8.55	12.05
3.75	8.62	12.37
4.00	8.70	12.70
4.25	8.77	13.02
4.50	8.85	13.35
4.75	8.92	13.67
5.00	9.00	14.00
5.25	9.07	14.32
5.50	9.15	14.65
5.75	9.22	14.97
6.00	9.30	15.30

What are the different forms of adulteration of milk often found?

1. Watering.
2. Skimming.
3. Watering and skimming.
4. The addition of preservatives.
5. Addition of coloring matter.
6. The addition of acid neutralizers.

How does watering affect the percentage of the different milk solids?

It reduces the percentage of all the milk solids, and reduces them in the same proportion.

How does skimming affect the percentage of the milk constituents?

It reduces the percentage of the fat and slightly increases the percentage of all other constituents.

How may the presence of added water in milk be determined?

Since the water of milk has the same chemical composition as pure water from any source, and the water content of milk varies to some extent, the presence of added water in small amounts cannot be determined directly. When the low lactometer reading, low fat content, or physical characteristics of the milk lead one to suspect that it is adulterated a control sample of the milk as produced by the cow or herd should be procured if possible. The composition of the two samples should be compared. If the suspected milk is to any great extent lower in quality, and especially if the per cent of

solids not fat is reduced, it is safe to conclude that the milk was watered.

If a sample of milk gives a Quevenne lactometer reading of 29, and is found, upon testing and applying the formula for solids not fat, to have 4 per cent of fat and 8 per cent of solids not fat, was it adulterated? How much, and what was the form of adulteration?

One may conclude that any milk having 4 per cent of fat should have at least 8.6 per cent of solids not fat. It would then be plain that the milk was watered, since the solids not fat are reduced approximately 7 per cent, determined as follows:

8.6—8=.6.

.6÷8.6=.0697×100=6.97 per cent of added water.

How may one detect when a sample of milk has been skimmed?

If the suspected sample has a low percentage of fat, higher lactometer reading, and an equal or larger percentage of solids not fat than the control sample, then it is safe to conclude that the milk was skimmed.

If a sample of milk has a Quevenne lactometer reading of 33 and contains 3 per cent of fat, was it adulterated? In what way was it adulterated, and how much?

Determine the solids not fat by the formula:

$\frac{L}{4}$ +.2F=solids not fat.

33÷4=8.25.

3×.2=.60.

8.25+.60=8.85=solids not fat.

By referring to the table given in answer to questions on page 70, it appears that milk having 8.85 per cent of solids not fat should contain 4.5 per cent of fat.

4.5—3=1.5 per cent of fat missing.

1.5÷4.5=.3333×100=33.33 per cent of the fat removed by skimming.

How may one detect when milk has been skimmed and watered?

Milk has been skimmed and watered if the percentage of all the solid constituents are reduced and the per cent of fat is reduced to a much greater extent than the other solids.

If a sample of milk contains 2.8 per cent of fat and 8.2 per cent of solids not fat, and the control sample contains 4.5 per cent of fat and 8.85 per cent of solids not fat, how was the milk adulterated and what was the per cent of adulteration?

By comparing the solids not fat in the two samples it will be seen that the milk has been watered, because the solids not fat are reduced. Calculate the per cent of added water by determining the quantity of solids displaced by it.

8.85—8.2=.65.

.65÷8.85=.0734×100=7.34 per cent of added water.

Next determine how much the fat is reduced.

4.5—2.8=1.7.

1.7÷4.5=.3777×100=37.7 per cent of fat missing.

Since we know that the solids not fat have been

reduced 7.34 per cent, and that watering reduces all milk solids in the same proportion, it follows that the fat was also reduced 7.34 per cent by watering. The total reduction of the fat minus 7.34 must have been lost by skimming.

37.77—7.34=30.43.

Therefore, the milk was watered 7.34 per cent, and 30.43 per cent of the fat was removed by skimming.

How should a factory man or shipping station agent determine whether milk has been watered or skimmed when it is impossible to secure a control sample?

First determine the composition of the suspected milk. Then compare the results with some standard. When suspected milk is furnished by an original producer it usually is not difficult to learn at least the breed of cattle producing the milk. If the herd is of a breed that produces milk of a high quality, then one should use a higher standard for comparison than in the case where the milk is from a herd of a breed that naturally produces milk of a low quality. If the herd is composed of mixed breeds or common stock it may be assumed that the pure milk is of average quality. To judge milk in this manner would be a difficult problem for one having no experience in dairy work, but an experienced factoryman or agent in a shipping station should have little trouble in gaining information sufficient to warrant a fairly reliable conclusion.

If a sample of milk contained 8.5 per cent of solids not fat and 3.3 per cent of fat, should it be considered as adulterated?

If one should learn that the milk was produced by a herd of Jersey cows, it should be considered adulterated. In that case the composition of the original milk would be at least 4.4 per cent of fat and 8.8 per cent of solids not fat. Those figures could be used as a basis for computing the kind and amount of adulteration. If the milk was produced by a Holstein herd, there would be the possibility that it was adulterated only in the sense that a herd of cows was selected which gave a low grade of milk, thus bringing the quantity of total solids below the legal standard of 12 per cent. If such milk was sold and no information could be gained regarding the character of the herd producing it, then it would be considered as having been actually adulterated.

What is the Hart casein test?

It is a method of testing milk for the percentage of casein it contains.

Upon what principles is the Hart casein test based?

1. That dilute acetic acid coagulates casein in an insoluble form heavier than the milk serum.

2. The ability of chloroform to extract the fat from the precipitated casein and form a solution heavier than the milk serum or coagulated casein.

3. Adopting a graduated tube and a volume of milk so that the volume of collected casein indicates on the scale the percentage of casein in the milk.

4. Applying centrifugal force to separate the serum, the casein, and the chloroform fat solution.

What pieces of apparatus are used in the Hart casein test?

1. A 5 c. c. pipette for measuring the milk.

2. A cylinder holding 2 c. c. to the mark, for measuring the chloroform.

3. A strong test tube 5.6 inches long. About 2.6 inches of one end is formed into a graduated neck one-half the diameter of the remainder, which forms the body. The body of the tube should hold 35 c. c. and the graduated part exactly 5 c. c. Each graduation on the scale represents .1 of 1 c. c., or .2 per cent of casein. The opening is at the large end of the tube.

4. A strong centrifuge properly constructed for holding the test tubes and geared to give a speed nearly twice as great as would be required in a Babcock fat test machine having a revolving disk of the same size.

5. A thermometer for determining the temperature of the milk and acid solution.

What reagents are used in the Hart casein test?

Dilute acetic acid and chloroform of the best quality.

How much and of what strength is the acetic acid used in the Hart casein test?

Use 20 c. c. of a solution containing 0.25 per cent of acetic acid.

How may an acetic acid solution of proper strength be made?

Add to 10 c. c. of pure glacial acetic acid 90 c. c. of water. Take 25 c. c. of this solution and make it up to 1,000 c. c. by the addition of water. The solution then contains 0.25 per cent of acetic acid.

How is the Hart casein test carried out?

Add 2 c. c. of the chloroform, 20 c. c. of the dilute acid, and 5 c. c. of the milk, in the order named, to the test tube. The temperature of the milk and acid solution must be within 5° of 70° F. A lower temperature tends to give a higher reading, and a higher temperature has the reverse effect. The thumb is placed over the opening and the tube inverted several times and shaken with some vigor for not more than 20 nor less than 15 seconds. The agitation must be just sufficient to thoroughly mix the contents and yet not form an emulsion. The tubes may be whirled in the centrifuge at once or may stand 20 to 25 minutes before whirling, if necessary. The speed of a revolving disk 15 inches in diameter should be approximately 2,000 revolutions per minute, and should continue seven and one-half to eight minutes. If the test has been properly made there will be found in the bottom of the tubes on taking them from the centrifuge a layer of the chloroform fat solution and immediately over it the layer of casein. Allow the tubes to stand 10 minutes after removing from the machines to allow the casein to come to a constant volume. Then read the test.

What points should receive special attention in making the Hart casein test?

1. The temperature of the milk and acid solution must be right.
2. The mixture must be shaken properly and for the right length of time.
3. The speed of the centrifuge must be sufficient, yet not too great.
4. Allow ten minutes to elapse after completing the whirling before reading the test.

What coloring matters are sometimes added to milk?

1. Annatto.
2. Coal-tar colors.
3. Caramel.

How does artificially colored milk differ in appearance from uncolored milk?

In uncolored milk the natural yellow is contained largely in the cream. In colored milk the color remains after the cream has risen or been removed. The skim milk does not show the familiar bluish tint when coloring matter has been added.

What is the nature of annatto coloring matter?

Annatto is a reddish-yellow coloring matter extracted by weak alkaline solutions from the pulp inclosing the seeds of a shrub that grows in South America and the West Indies. The alkaline solution is used for coloring purposes.

Give a simple test for annatto coloring in milk.

In a tightly corked vial or test tube shake

vigorously 10 c. c. of milk and an equal volume of ether. If annatto is present the amount will be indicated by the depth of the yellow coloring in the ether layer which forms on the surface when standing quiet.

How may foreign color be detected in milk?

The following method was developed by Leach:

1. Warm about 150 c. c. of milk in a porcelain dish and add about 5 c. c. of acetic acid, after which slowly continue the heating to the boiling point while stirring. Gather the curd, when possible, into one mass by the stirring rod and pour off the whey. If the curd breaks up into small flakes, separate from the whey by straining through a sieve. Press the curd free from adhering liquid, transfer to a small flask, and macerate for several hours (preferably overnight) in about 50 c. c. of ether, the flask being tightly corked and shaken at intervals.

2. Detection of annatto in the ether extract. Decant the ether as obtained above into an evaporating dish and evaporate the ether over hot water. Make the fatty residue alkaline with sodium hydroxide, and pour upon a very small wet filter while still warm. After the solution has passed through, wash the fat from the filter with a stream of water and dry the paper. If, after drying, the paper is colored orange, the presence of annatto is indicated. Confirm by applying a drop of stannous chlorid solution, which, in the presence of annatto, produces a characteristic pink on the orange-colored paper.

3. Detection of coal-tar color (" aniline orange ") in the curd. The curd of an uncolored milk is per-

fectly white after complete extraction with ether, as is also that of milk colored with annatto. If the extracted fat-free curd is distinctly dyed an orange or yellowish color, aniline orange is indicated. To confirm the presence of this color, treat a lump of the fat-free curd in a test tube with a little strong hydrochloric acid. If the curd immediately turns pink, the presence of aniline orange is assured.

4. Lythgoe's test for aniline orange is as follows:

Treat about 10 c. c. of the milk with an equal volume of hydrochloric acid (specific gravity 1.20) in a porcelain casserole and give the dish a slight rotary motion. If an appreciable amount of aniline orange is present, a pink color will at once be imparted to the curd particles as they separate.

5. Detection of caramel (in the curd). If the fat-free curd, after extraction with ether, is colored a dull brown, caramel is to be suspected. Shake a lump of the curd with strong hydrochloric acid in a test tube and heat gently. In the presence of caramel the acid solution will gradually turn a deep blue, as will also the white fat-free curd of an uncolored milk, while the curd itself does not change color. It is only when this blue coloration of the acid occurs in connection with a brown curd, which itself does not change color, that caramel is to be suspected, as distinguished from the pink coloration produced at once under similar conditions by aniline orange.

Name several of the preservatives that are sometimes used in milk.

1. Peroxides.
2. Borax and boric acid.

3. Formaldehyde.
4. Benzoates and benzoic acid.
5. Carbonate and bicarbonate of soda.
6. Salicylic acid.

How may the presence of peroxides in milk be detected?

Add to 15 or 20 c. c. of milk in a milk test bottle or test tube a quantity of paraphenylenediamin hydrochlorid the size of a pea and shake the mixture vigorously for five or ten seconds. If peroxides are present the milk will turn blue within a few minutes. When the blue solution is made alkaline the color changes to a yellowish light red. If the peroxide has been in the milk for a long time, the test may not work well.

How may borax or boric acid in milk be detected?

To 50 c. c. of the milk add enough sodium hydrate to make alkaline. Evaporate the solution to dryness and incinerate. Acidify the ash with a small amount of strong hydrochloric acid. A strip of tumeric paper is then soaked in the solution for a few minutes and afterward dried on a clean glass or porcelain surface. If the paper when dry is a reddish color and turns to a dark olive green on the addition of dilute ammonia, the presence of boric acid or borates is assured.

How may the presence of formaldehyde in milk be detected?

To 15 or 20 c. c. of milk in a Babcock milk test bottle or in a test tube add 4 or 5 drops of a 10 per cent solution of ferric chlorid. Then add a volume of

sulphuric acid equal to the volume of milk taken. Shake the bottle in a circle, but not sufficient to mix the milk and acid to any great extent. In the presence of formaldehyde a deep bluish-violet coloration appears in the circle where the milk and acid join. Hydrochloric acid having a specific gravity of 1.2 may be substituted for sulphuric acid in the test.

How may the presence of carbonates in milk be detected?

1. The ash of milk containing carbonates will effervesce upon the addition of a few drops of diluted hydrochloric acid. This is a strong indication of added carbonates.

2. Add to 10 or 15 c. c. of the milk an equal volume of alcohol and a few drops of a 1 per cent solution of rosalic acid. In the presence of carbonates a rose-red color appears, while pure milk shows a light yellowish-red color.

How may the presence of benzoic acid in milk be detected?

Add 5 c. c. of dilute hydrochloric acid to 50 c. c. of the milk in a flask and shake to curdle. Extract the curdled milk with successive portions of ether. Transfer the ether to a separatory funnel and shake with dilute ammonia, which separates the benzoic acid from the fat, in the form of ammonium benzoate. Draw off the ammoniacal solution and evaporate in a dish over hot water until all free ammonia has disappeared, but before dryness is reached add a few drops of ferric chlorid reagent. A flesh-colored precipitate indicates benzoic acid.

All free ammonia should be driven off, otherwise ferric hydrate would be formed.

How may the presence of salicylic acid in milk be detected?

The acid is seldom used as a preservative in milk. If its presence is suspected, proceed exactly as in testing for benzoic acid. On applying the ferric chlorid to the solution after the evaporation of the ammonia a violet color indicates the presence of salicylic acid.

How can the presence of starch in milk be detected?

To 10 or 15 c. c. of milk in a test tube or vial add a few drops of an iodine solution. If starch is present it will be colored blue by the iodine.

How may milk that has been heated to 175° F. be detected?

1. To 15 or 20 c. c. of milk in a small bottle or test tube add 1 c. c. of a concentrated starch solution and 6 or 8 drops of a 10 per cent solution of potassium iodid. Next add 4 or 5 drops of a 2 per cent solution of hydrogen peroxid. Upon shaking the mixture it will turn to a dark blue color if the milk has not been heated to 175° F.

2. In the same manner as above, add a quantity of paraphenylenediamin hydrochlorid about the size of a pea and 4 or 5 drops of a 2 per cent solution of hydrogen peroxid. The mixture turns blue on shaking if the milk has not been heated to 175° F.

What causes the color of the milk to change in the tests for heated milk?

The enzymes of the milk set free oxygen from the hydrogen peroxid and the free oxygen sets free iodine from the potassium iodid. Then the free iodine colors the starch blue. When the enzymes are destroyed by heat no action takes place and the milk remains white.

In the second test the oxygen, set free by the enzymes, acts upon the other reagent, causing it to change to a blue color.

What are the common ways of adulterating cream?

1. By diluting the cream with milk.
2. By the addition of thickeners.
3. By the addition of preservatives.
4. By the addition of acid neutralizers.

How may the tendency to dilute the cream be overcome?

By buying and selling cream upon the basis of the fat content.

How may the presence of condensed milk or condensed skim milk in cream be detected?

Separate the fat of the cream from the serum. Determine the per cent of solids not fat in the serum. If the serum contains a greater percentage of milk solids not fat than is found in skim milk, the presence of condensed milk or condensed skim milk is assured.

How may the presence of gelatin in cream be detected?

Prepare an acid solution of mercuric nitrate by dissolving mercury in twice its weight of nitric acid of 1.42 specific gravity, and diluting the solution to 25 times its bulk with water. To 10 c. c. of the cream to be examined, add an equal volume of acid mercuric nitrate solution, shake the mixture, add 20 c. c. of water, shake again, allow to stand five minutes, and filter. If much gelatin is present the filtrate will be opalescent and cannot be obtained very clear. To a portion of the filtrate contained in a test tube add an equal volume of a saturated aqueous solution of picric acid. A yellow precipitate will be produced in the presence of any considerable amount of gelatin, while smaller amounts will be indicated by a cloudiness. In the absence of gelatin the filtrate obtained will be perfectly clear. The test will work equally well for determining the presence of gelatin in milk.

How may the presence of starch in cream be detected?

By adding a small amount of iodine solution as in the test for starch in milk. A slightly larger quantity of the iodine solution should be added, as the greater amount of fat in cream will absorb more of the iodine.

What substances are often used as cream thickeners?

1. Sucrate of lime (viscogen).
2. Condensed milk or condensed skim milk.
3. Gelatin.
4. Starch.

How is sucrate of lime made?

Slake 3 pounds of freshly burned lime in hot water. Make the quantity up to 5 gallons by adding water. Dissolve 10 pounds of sugar in five gallons of water. Mix the two solutions and stir at intervals for about three hours. Let settle and use the clear solution.

How may the presence of viscogen in cream be detected?

Determine the number of c. c. of $\frac{N}{10}$ acid required to neutralize the ash from 100 grams of the cream. The $\frac{N}{10}$ acid should be added in excess and titrated back with $\frac{N}{10}$ alkali. If more than 14 c. c. are required it is a strong indication that viscogen is present in the cream.

How may the presence of preservatives in cream be detected?

The methods used for detecting preservatives in milk may be applied to cream as well. In some cases it may be necessary to dilute the cream before applying the tests.

How may the presence of acid neutralizers in cream be detected?

The substances used to neutralize the acid are alkalies or carbonates and the methods for detecting them are the same as those used on milk.

How is butter sometimes adulterated?

1. By substituting a foreign fat for the whole or a part of the butter fat.
2. By selling renovated butter as fresh butter.

3. By incorporating an excess of moisture during the process of manufacture.

4. By the addition of preservatives.

How may renovated butter and oleomargarine be distinguished from butter?

1. Melt some of the substance in a spoon by holding it over a small flame. Let the melted fat boil vigorously. Renovated butter and oleomargarine snap and sputter with noise while boiling and very little, if any, foam is formed. In boiling, butter makes little noise and a large amount of foam forms.

2. On melting butter and allowing the casein and water to settle a transparent oil results. With oleomargarine or renovated butter the oil remains cloudy.

How may renovated butter and oleomargarine be distinguished?

Heat about half a pint of milk in a tin cup to 140° F. Add to this a tablespoonful of the substance. Stir with a wooden stirring rod until melted. Then set the cup in ice cold water and stir until the fat hardens. It may then be collected into a lump with the wooden stirring rod if it is oleomargarine, but will remain separated in fine granules if it is butter or renovated butter.

What is one of the best methods for distinguishing butter from oleomargarine?

By determining the Reichert-Meissl number.

What is meant by the Reichert-Meissl number?

It means the number of c. c. $\frac{N}{10}$ alkali required to neutralize the volatile acids from 5 grams of the fat.

How is the Reichert-Meissl number determined?

Five grams of the fat are placed in a clean, dry flask of 300 c. c. capacity, 10 c. c. of 95 per cent alcohol added, and 2 c. c. of a saturated aqueous solution of sodium hydrate. Place a funnel in the neck of the flask and heat on the water bath with occasional shaking until saponification is complete, when the solution will be free from fat-globules and perfectly clear. Then remove the funnel and continue heating over the bath to dryness. Add 135 c. c. of water and warm on the water bath with shaking until the soap is dissolved. Cool and add a few small pieces of pumice stone, to prevent lumping while boiling, and 5 c. c. of dilute sulphuric acid (200 parts of acid to 1,000 parts water). Connect the flesk with a condenser and distill off 110 c. c. in about 30 minutes. Titrate the entire distillate with tenth-normal alkali, using phenolphthalein as indicator. The number of cubic centimeters of tenth-normal alkali required express what is called the Reichert-Meissl number.

How does the Reichert-Meissl number for butter and for oleomargarine differ?

The size of the Reichert-Meissl number for oleomargarine usually depends to a great extent upon the per cent of butter present in the oleomargarine. This number is not often more than 5 for oleomargarine and rarely less than 24 for butter. The

Reichert-Meissl number for butter is usually between 24 and 31.

What fats are sometimes used to adulterate butter?

Lard and beef fat or products manufactured therefrom, as lard stearin and beef stearin. Stearin derived from cottonseed oil is also used. Fats or oils from any source may be used provided they have the proper melting point when mixed and no strong flavors.

What fats are used in the manufacture of oleomargarine?

Neutral lard, beef fat stearin and cottonseed oil stearin are the principal fats used in nearly all the oleomargarine now manufactured. Cottonseed oil stearin is probably not used to so great an extent as the others. Small quantities of a few other oils are sometimes added to change the color to more nearly resemble that of butter.

What is neutral lard and lard stearin?

Neutral lard is the best quality of lard made from hog fat. The fat is rendered at a low temperature and the product washed with water containing a little sodium carbonate, salt, or dilute acid. The product then has only a slight acidity and is almost tasteless. Its principal use is in the manufacture of oleomargarine. Lard stearin is made by melting lard and holding it at a temperature between 50° and 60° F., until the stearin separates in crystals. It is then filtered and pressed in cloth sacks. The oil obtained is used for illuminating and lubricating purposes. The stearin

which is collected in the sacks is mixed with other fats and manufactured into oleomargarine or compounds like lard and cottonseed oil.

How is oleomargarine manufactured?

The process of manufacture depends somewhat upon the ingredients used and the markets to be supplied. When the product goes to a tropical country oils of higher melting points are used in larger quantity than when the product goes to colder climates. In general the oleo oil from beef tallow, the neutral lard or lard stearin from hog fat, and the cottonseed oil stearin are mixed in proportions giving a melting point about that of butter. The mixture is then churned with skim milk or whole milk and the process thereafter is practically the same as that for the making of butter from cream.

What preservatives may be used in butter?

1. Boric acid or borates.
2. Formaldehyde.
3. Salicylic acid.
4. Sulphurous acid.

How may the presence of boric acid or borates be detected in butter?

Melt an ounce or two of the butter at the temperature of boiling water and collect the aqueous solution at the bottom. To a small amount of the aqueous solution add a few drops of hydrochloric acid. Then apply tumeric paper to the liquid. If the paper turns red upon drying and turns to a dark

olive green upon being made alkaline with ammonia the presence of boric acid is assured.

How may the presence of formaldehyde in butter be detected?

Melt the butter at a low temperature and separate some of the water solution that collects at the bottom. To this add milk free of formaldehyde. Then test the mixture for formaldehyde by adding a few drops of ferric-chlorid solution and concentrated sulphuric or hydrochloric acids, as in the case with milk. A violet blue color assures the presence of formaldehyde.

How may the presence of salicylic acid in butter be detected?

Separate some of the water solution that settles to the bottom on melting the butter and follow the directions given for the detection of salicylic acid in milk.

How may the presence of sulphurous acid in butter be detected?

Separate some of the water solution that settles out on melting the butter. Distill off a part of it and to the distillate add bromine water and barium chlorid. A precipitate indicates the presence of sulphurous acid or a sulphite in the butter.

How is butter tested for its salt content?

1. Weigh into a glass beaker 10 grams of butter. Add about 20 c. c. water. Warm it to melt the butter and then transfer the butter and water to a separatory funnel. Insert the stopper. Shake for

a few moments. Allow the mixture to stand a few minutes until any remaining fat has collected on the surface. Then draw the water into a flask, being sure that no fat passes through. Again add hot water to the beaker and repeat the washing in the funnel several times, using 15 c. c. of water each time.

Determine the sodium chlorid in a measured part (10 c. c.) of the liquid by titrating with standard silver nitrate solution, using potassium chromate as an indicator. 1 c. c. $\frac{N}{10}$ silver nitrate solution=.005837 grams of salt.

To determine the total amount of salt divide the total number c. c. of water used by 10 and multiply by .005837. This will give the total number grams of salt in 10 grams of butter. Then, knowing the amount present in 10 grams, it is an easy matter to determine the amount in 100 grams by multiplying by 10. This gives the percentage of salt in the butter tested.

2. Gray's salt test. A representative 10-gram sample of butter is placed in a small glass dish. The dish is then half filled with boiling water and the mixture of fat and water poured into a 500 c. c. glass flask. The dish is rinsed several times with hot water and each time the rinsings are poured into the flask. The flask is then filled to the 500 c. c. mark with boiling water and thoroughly shaken. Then allow the contents of the flask to cool and after the fat has collected on top and hardened, measure with a pipette 50 c. c. of the clear solution beneath the fat and place it in a clean glass dish. Fifty c. c. of a potassium chromate indicator is then added and the solution titrated with a standard

silver nitrate solution. The strength of this silver nitrate solution is such that 1 c. c. of it represents one-tenth of 1 per cent of salt.

3. The Fitch salt test. A representative 3.5-gram sample of butter is placed in a 300 c. c. glass flask and 180 c. c. of boiling water added. The flask is then corked and thoroughly shaken, care being taken to remove the cork often to relieve the pressure. The mixture is then allowed to cool and after the fat has collected on the top and solidified 17.6 c. c. of the clear solution beneath the fat is placed in a white cup. Then 17.6 c. c. of potassium chromate indicator is added and the solution titrated with a standard silver nitrate solution measured from a graduated cylinder till the solution becomes a permanent reddish color. The number c. c. silver nitrate used divided by 10=per cent salt.

How is the moisture content of butter determined?

1. By chemical analysis.
2. By practical moisture tests.

What are the names of the more commonly used moisture tests?

1. Cornell test.
2. Mitchell-Walker.
3. Irish.
4. Gray's.
5. Farrington.

How should a representative sample of butter be secured and prepared for making a moisture, salt, or fat test?

From the mass of butter to be tested take several

samples from various parts. The samples when added together should make about 6 ounces. These are placed in a wide-mouth sample bottle or fruit jar and placed in hot water until the butter melts to the consistency of thin cream. While melting, the butter should be thoroughly and continuously stirred with a table knife or similar instrument. The bottle should then be well shaken to secure a uniform mixing of the sample. The bottle is then placed in cold water to solidify, but while cooling the butter should be stirred continuously. As soon as the butter has become fairly solid or plastic, the sample for testing can be secured. If in melting the butter becomes oily great care and skill must be used to reincorporate the water evenly during cooling.

Describe and give directions for using the Irish moisture test.

A representative 10-gram sample of butter is placed in a small metal cup and held over a flame with a pair of special forceps until all the moisture has evaporated from it. While the butter is heating it foams considerably. As soon as the foaming has ceased, and before the fat begins to char, a small mirror is held over the cup to show if any moisture still remains. When the sample is thus freed from moisture it is cooled to room temperature, 60° F. to 70° F., and reweighed upon a special scale by which the difference between the weight of the butter before and after heating is indicated in the form of percentage by the use of small weights.

Describe and give directions for using Gray's moisture test.

This test consists of a scale, glass flask, graduated glass tube, condenser, amyl reagent, and an alcohol lamp.

A representative 10-gram sample of butter is placed in the glass flask. To this 6 c. c. of amyl reagent is added and the different parts of the test then connected for use. The condenser is filled with cold water. The butter and amyl mixture is heated over a flame, the moisture is driven off and collects in the graduated glass tube, where it can be read in the form of percentage. The heating is stopped as soon as the mixture in the flask becomes brown and the crackling noise ceases. This usually requires about six minutes.

Should heat be applied too severely to the flask the steam may go above the 15 per cent mark. This should be prevented by withdrawing the heat for a short time. Great care must be exercised in collecting all the moisture in the graduated tube if reliable readings are to be secured.

Describe and give directions for using Farrington's moisture test.

In Farrington's test 10 grams of a representative sample of butter is placed in a small dish. The dish is then placed in a special oven heated to from 240° F. to 270° F. under steam pressure. Here the butter is left until all moisture has been evaporated, indicated by the browning of the casein in sample. This usually takes about 30 minutes. After the moisture has been evaporated the dish and its contents is reweighed and the difference from the

original weight determined. The per cent moisture can thus be easily determined. Occasionally a reverse beam scale is used upon which the per cent moisture evaporated can be read direct.

Describe and give directions for using the Cornell moisture test.

This is a simple, accurate, and durable test recently prepared by Mr. H. E. Ross of the dairy department of the New York state college of agriculture. The test resembles the Irish test, but has several important improvements.

A 10-gram sample of butter is secured in the usual way. This is placed in a special cast aluminum cup and the cup held over a flame with special forceps or placed on some heated surface. The important features of the test are the use of this cup and the use of a thin sheet of asbestos between flame or heated surface and the cup. The asbestos prevents all the sputtering of the heating butter and eliminates a great deal of the danger of charring. The sample is heated till all moisture is driven off. This usually requires about 25 minutes, and is indicated by the casein losing its snow-white color and becoming brown. The sample is then cooled and reweighed with a special scale upon which the per cent moisture can be read directly and accurately.

Describe and give directions for using the Mitchell-Walker test.

The apparatus in this test consists of a metal evaporating cup, condenser, graduated glass receiver, scale for weighing sample, spirit lamp, amyl

acetate reagent, and a stand to support the apparatus.

A representative 10-gram sample of butter is placed in the metal cup. To this is added 10 c. c. of the amyl acetate reagent. The apparatus is then connected and the condenser filled with cold water. The alcohol flame is then applied under the evaporating cup. In about a minute the water and reagent will begin to pass over and drop from the condenser tube into the receiver. After all the water has been evaporated from the cup, the reagent will cease dropping for a moment and then begin again as soon as it has reached its own boiling point, which is higher than that of the water. Continue to apply the flame until practically all the reagent is driven off and it ceases to drop freely from the condenser tube. By this means all the water is washed out of the condenser tube and the major portion of the reagent is recovered. The flame is now extinguished. The mouth of the receiver is corked and taken by the top and shaken a few times to detach any drops of water that may adhere to the sides.

The per cent moisture can now be read in the graduated receiver. The water is withdrawn from the receiver, and then the reagent, which is collected in a bottle and preserved for use in later tests.

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