

### The Dairy.

#### Composition and Characteristics of Milk—How to Make Tests for Adulterations and Quality.

[From the German: Translated by W. A. Macdonald for the FARMER'S ADVOCATE.]

In order to thoroughly comprehend the natural and artificial characteristics of milk, the following points must be weighed:

1. A knowledge of the composition of pure, whole, unadulterated milk, and likewise of the skim-milk and the cream.
2. A knowledge of the practiced methods of adulteration.
3. An apt manipulation of the most approved methods used in the detection of adulterations.

##### I. PURE COW'S MILK.

Pure, unadulterated cow's milk is a pale white non-transparent liquid, of a pure, mild, sweetish taste, with a faint odor which reminds a person of the perspiration of the cow. It is fatty to the touch. A single drop remains on the dry finger nail tightly cushioned out and highly arched, and has opaque borders. It colors red litmus paper blue, blue litmus paper red, and so possesses amphotere reaction. It does not curdle by boiling. Under the microscope, an extraordinarily great number of small, strongly light-breaking globules are seen, in which form all the butter fat in the milk is suspended.

Real, normal milk has the essential property of a fixed specific gravity. It is heavier than water, when like volumes are compared. Placing the weight of a given volume of water at 1,000, the weight of an equal volume of milk from individual cows at 15° C. (59°F), will be 1,027 to 1,040; and a mixture of milk from several cows will have a specific gravity between 1,029 and 1,034 at 15° C.

Pure cows' milk has the following average percentage composition:

Water	86.23	} = 100.00
Dry substance	13.77	

The dry substance has the following average composition:

Fat	4.50	} = 13.77
Milk sugar	4.93	
Casein	3.23	
Albumin	0.60	
Mineral matter (ash)	.61	

The percentage of water does not vary very much. With individual milkers, it varies between 85 and 89%; with mixed milk, 86-88%, the percentage of dry matter thereby varying from 12 to 14 percent.

The normal milk from individual cows may fluctuate, in fat percentage, between 2.5 and 7%, the general variations, however, being between 3.5 and 5%. Unadulterated, marketable milk should not contain less than 3% of butter fat.

The milk sugar varies from 3 to 6%; in the milks in the markets mostly about 4 percent. It decomposes under the influence of a ferment, the so-called souring, bringing about spontaneous curdling, by which the casein mixed with the milk fat separates from the whey. The casein varies from 2 to 5 percent (average 3½-4%). When the clear whey is heated, another albuminous body separates, called *zieger*. The percentage of ash varies from 0.4 to 0.8%. It includes phosphates, chlorides, and potash, soda, lime and iron salts.

After standing for some time, there appears on the surface of the milk a dense, distinctly

marked layer of yellowish-white appearance—the cream. This consists mainly of butter globules which have risen to the surface owing to their greater lightness. It contains a much greater percentage of fat than the milk (40-70%); but the percentage of water is much less than that in the milk (22-74%). In suitable vessels, the cream ceases to rise after 12-24 hours. Good market milk should produce at least 10 percent of cream by volume in this time. Genuine cream should not produce less than 25 percent of fat, should be of a thin honey consistence, of a pure smell and taste, and should be as free as possible from mould and other fungoid growths. It is worthy of note that watered milk gives proportionably more cream than unwatered.

The skim or blue milk contains less fat and more water than the whole milk, and it is specifically heavier. It should not contain over 91% of water, the fat should not be under ½%, and the specific gravity varies between 1,032 and 1,040 at 15° C.

##### II. ADULTERATIONS OF MILK.

Milk must be regarded as adulterated—

1. When one of its constituent parts is wholly or partially wanting—unless the fact is stated at the time of sale; for example, skimming.
2. When some substance is added, which increases the weight or volume, thereby disturbing the proportion of the milk constituents; for example, water.
3. When some stuff is put into the milk for the purpose of giving it the appearance of purity, in order to make up for the substance extracted; for example, starch, meal, etc.
4. When it contains some constituent which is deleterious to the health of the consumer; for example, the milk from unhealthy cows.

The ordinary adulterations of milk are for the most part easy to detect. They consist mostly in partly abstracting the cream, or adding water, mostly both together. It seldom happens that a denser-making substance is added in order to compensate for the thinness of the milk; for example, starch, meal, gum, sugar, salt.

The following facts will be found very useful in determining the customary adulterations:

1. A higher specific gravity than 1,034, a low volume of cream (under 10%), a small increase in the percentage of water (over 88%), an appreciable diminution in the percentage of fat (under 3%).
2. A specific gravity under 1,029, showing much or little abstraction of cream, a higher than normal percentage of water, i.e., much over 88%, and a fat percentage under 3%, shows simply the addition of water, particularly when the milk skimmed shows a specific gravity under 1,032. The quantity of water added can be ascertained by the variations from the normal specific gravity—for each 0.03 under 1,029 one tenth water can be reckoned, or the percentage of water added can be ascertained chemically. By the latter method each percent of water over 88 may be regarded as 7% of water added.
3. A specific gravity within the normal range (1,029-1,034), or very little thereunder, with only a small percentage of cream, a much lessened percentage of fat, and a marked increase in the percentage of water, show that skimming has been practised, water at the same

time being added. The skim from such milk shows less than the normal value by the specific gravity determination.

4. A specific gravity near the higher boundary (1,034), or very little thereunder, a normal or very little increased percentage of water, with a small volume of cream, and a much reduced percentage of fat, with a normal specific gravity of the obtained skim-milk, show that skim-milk has been added.

5. A specific gravity near the lower boundary (1,029), or thereunder, an increased percentage of water, a low volume of cream, and a greatly reduced percentage of fat, with a reduced specific gravity of the obtained skim-milk, show that the milk has been adulterated with skim-milk, water at the same time being added.

##### III. METHODS OF DETERMINING MILK ADULTERATIONS.

The instruments used for the investigation of milk adulterations must be such that frequent determinations can be made in a short time. It must determine, in a simple manner, any single adulteration in a large mass of milk. In all tests for adulterations, the following rules should be observed:

1. The milk must possess the normal character judged by the sensible qualities, viz., color, smell, taste, and the nail test.
2. It must show an amphotere reaction.
3. Its specific gravity must lie within the normal ranges, viz., 1,029-1,034 for whole milk; 1,031-1,036 for half skimmed milk; 1,032-1,040 for skim-milk.
4. The percentage of fat in whole milk must not be less than 3%; in half skimmed milk not under 1½%.
5. When there is suspicion of adulteration by the addition of starch or meal, a few drops of iodine solution (iodine in iodide of potassium) should be used; the milk's turning blue will confirm the suspicion.

##### REMARKS BY THE TRANSLATOR.

The difficulty now to be presented is to ascertain the cheapest, most accurate, and most expeditious instruments for testing the quality of milk according to the above rules and principles. The question as to the best standard to be adopted for Canada may also arise. The analyses made of the milk of our breeds and grades have been far too limited to establish standards. The authority whose writings are above translated gives 4.50 as the average percentage of fat, and 13.77 of total solids; while another German authority, evidently taking the averages of breeds in other parts of Germany, adopts 3.40 for the fat and 12.35 for the total solids as the standards. The averages of many thousands of analyses taken from different parts of the world give 13.14 percent for the total solids and 3.98 for the fat. Boston milk (1885) gives 13.30 and 3.50 respectively, and the New York Dairy Commissioners (1885) give 13.73 and 4.21. The New York State law demands that milk containing less than 12 percent of solids and 3 percent of fat shall be considered as adulterated. In analyses made of the milk of 50 pure bred Shorthorns belonging to the St. Albans dairy herd, there was an average of 13.24 percent of solids and 3.59 of fat. The British Dairy Farmers' Association, in an average of several breeds and grades for eight years, gives an average of 13.50 percent for the total solids, and 4.08 for the fat. Pub-