

Cause of Variation in Per Cent of Fat of Market Cream from Farm Separators

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(Compiled from various Experiment Station Bulletins.)

The question of variation in per cent of fat in cream marketed at the different creameries causes considerable trouble at times among its patrons, and will continue to do so until the farmers understand more fully the conditions that cause this variation. Most farmers have learned that by proper adjustment of the cream screw the per cent of fat in the cream may be increased or decreased; but they have noticed that their cream tests have varied from two to fifteen per cent or more from week to week, or from season to season, even when the cream screw had not been changed.

The farmer is apt to conclude that when the milk is from the same herd, and there are no apparent irregularities in feeding, milking or separating the cream, the per cent of fat in the cream should not vary. The extreme variations in tests are likely to cause him to feel that the cream is not being accurately tested. The fact is, a uniform test from week to week would be more indicative of dishonesty than a variation of a few per cent in the test. Occasionally an incorrect test is made, but this is an exceptional cause for variation rather than a usual one.

It is very true that great care is needed to test cream accurately, and there may be operators of the Babcock test who are incompetent and unreliable, but such operators are not long tolerated by any creamery manager.

Factors affecting the per cent of fat found in cream, other than possible inaccurate and dishonest testing, may be summarized as follows:

- 1st. Richness of milk separated.
- 2nd. Changes in temperature of milk.
- 3rd. Speed of separator bowl.
- 4th. Rate of inflow to separator bowl.
- 5th. Amount of skim milk or water used in flushing the separator bowl.

Any one of these five phases of separator management will influence the test of cream, even when the cream screw has not been changed. However, if a variation in these conditions is avoided as much as possible, the richness of the cream may be controlled to a great extent.

Effect of Richness of Milk Separated on the Per Cent of Fat in Cream

When the cream screw is set to deliver a certain per cent of fat in the cream, under normal conditions there will be a definite ratio between the skim milk and cream separated. That is, if the separator delivers twelve pounds of cream and eighty-eight pounds of skim milk from 100 pounds of three per cent milk, the test of the cream would be 25 per cent. On the other hand, if a four per cent milk is separated under the same conditions, instead of getting more cream than from the three per cent milk, we would get approximately the same amount, viz, twelve pounds, but it would test about 33 per cent. The change in per cent of fat in milk is caused by several factors, one of which is the change from dry feed to succulent pasture, which results in a decreased fat percentage. On the other hand, in the fall and winter when the cows are advanced in lactation, and are put on dry feed, fat percentage is increased. The following table, taken from Bulletin No. 150, Indiana Agricultural Experiment Station, shows results of experiments in which the cream obtained from milk containing different percentages of fat varied from 20 to 39 per cent, though the milk was run through the same separator under the same conditions, without changing the cream screw:

Milk Per cent of Fat	Cream Per cent of Fat	Skim Milk Per cent of Fat
3.0	20.0	.06
4.5	32.5	.06
6.0	39.0	.14

Effect of Changes in Temperature on Per Cent of Fat in Cream

Milk, when drawn from the cow, has a temperature of about 90 to 95 degrees Fahrenheit, the best practical temperature at which to separate it. If the milk is allowed to cool much lower than 85 to 90 degrees Fahrenheit, as is likely to be the case in the winter, it should be warmed up before separating, thereby avoiding considerable loss of fat in the skim milk and variation in the richness of the cream.

Changes in temperature of milk separated cause a variation ordinarily from three to four per cent of fat in the cream. This is well shown in the following table:

Temperature of Milk, °F.	Per cent of Fat in Cream	Per cent of Fat in Skim Milk
Lot 1 90-95	21.2	.02
..... 50-60	31.7	.75
Lot 2 90	27.3	.022
..... 75	23.5	.051
..... 60	36.7	.120

These figures show an increase of ten per cent fat in the cream in separating milk between 50 and 60 degree Fahrenheit, with a serious loss of fat in skim milk.

Effect of Speed of Separator on Per Cent of Fat in Cream

The effect of speed of the separator bowl on the per cent of fat in cream is probably greater than any other cause. The higher the speed the greater the centrifugal force; and the more rapidly the skim milk will leave the bowl. Thus, if the speed is increased, the capacity of the skim milk outlet increases, which leaves less milk for the cream outlet; consequently a richer cream results. Variation in speed may cause a difference, under ordinary conditions, of five per cent to twenty per cent of fat in cream separated, the difference in richness being greater when the machine is set for a thick cream than when set for a thin cream. The table below shows the effect of speed on variation of per cent of fat in cream:

Lot	Speed in Turns	Cream		Skim Milk	
		Lbs.	% Fat	Lbs.	% Fat
Lot 1	25 too low	9.6	10.8	39.9	2.73
	Normal—50-60	5.0	42.2	44.7	.06
	25 too high	3.3	62.7	46.3	.03
Lot 2	20 too low		23.0		.21
	Normal		28.5		.029
	10 too high		32.0		.029

Effect of Rate of Inflow on Richness of Cream

Every cream separator is limited to a definite capacity, and any machine is operating at its greatest efficiency when the amount of milk separated per hour is kept within this definite capacity. Crowding a separator will give thinner cream, with a large loss of fat in the skim milk. If the rate of inflow is decreased it results in, first, smaller amount of cream in proportion to skim milk; second, higher per cent of fat in cream; and, third, loss of fat in skim milk not materially affected.

The amount of milk in supply tank which enters the bowl affects the per cent of fat in cream. The more milk there is in the tank, the more rapidly will the milk flow through the bowl on account of the greater pressure. If the tank is kept one-third full, the cream will be thicker than when the tank is kept brim full. An average of results of the effect of the rate of inflow in thickness of cream and on per cent of fat in skim milk is shown in the following table:

Machine	Rate of Inflow	Loss % of Fat in Skim Milk		% of Fat in Cream
Machine A	Normal	.06		44.3
	Small	.08		70.0
	Large	.19		32.8
Machine B	Normal	.028		29.0
	Small	.027		30.0
	Large	.145		23.0

The above table shows an increase of from six to twelve per cent fat in the cream of the larger inflow over that of the normal inflow, and considerable loss in fat in the skim milk from the large inflow.

Effect of Amount of Skim Milk or Water Used to Flush the Separator Bowl

If just enough flushing is used to discharge the cream remaining in the separator bowl, the per cent of fat in the cream will not be materially changed. When an excess of water or skim milk is used the fat test in the cream is lowered considerably. It is a better plan to pour the flush water or milk into the supply tank; then it will gradually run into the machine, and most of it will then pass through the skim milk outlet, making little change in the richness of the cream, while great variation in the richness of the cream is brought about by the practice of removing the float and pouring the flush water or skim milk directly into the bowl. In the latter case the machine is not able to handle the rapid flow, so more runs into the cream, thereby lowering the per cent of fat.

Amount of Flush Water	Average % of Fat
None	37.3
Same as capacity of bowl	37.3
Enough to make cream discharge watery	35.0
Twice the last amount	33.5

A decrease of from one to ten per cent in fat in cream may be caused by variation in the amount of flush water or skim milk used.

There are still a few other factors that affect the changes in per cent of fat in cream, such as: cleaning the separator, acidity of milk, and smoothness of the running of the separator bowl. The gravity methods that are sometimes used in separating milk cannot be expected to give a uniform test in the cream.

The proper cleaning of the separator after each separation is of great importance. Cream that is separated by separators that have not been washed after each separation, or only washed once in two or three days, is dangerous to health and unfit for buttermaking. The mere running of warm water through the machine after separation is not sufficient cleansing to insure a first grade cream. In order to remove the portion of cream clinging to the inside of the bowl, and particularly the separator slime, which readily decomposes, it is necessary to take the bowl apart and thoroughly cleanse it. Furthermore, there is a considerable loss of fat in skim milk caused by an unclean separator bowl, which no farmer can well afford to disregard. The following average of a series of experiments shows the loss of fat in skim milk from an unclean separator to be three times as great as the loss where the separator is washed after each separation:

Loss of per cent of fat in skim milk when separator was—	Per cent
Washed after each separation	.038 per cent
Washed once a day	.10 per cent

Separating Sour Milk

Milk that has curdled will separate with difficulty. Previous to separating, such milk should be thoroughly mixed by pouring from one can to another, breaking up the curd as finely as possible, so as not to clog the machine. The separation of curdled milk finally clogs the skim milk tubes, with the result that more skim milk passes through the cream outlet, making a thinner cream. While, on the other hand, when sour milk which has not curdled is separated, the cream produced will be thicker. This is due to the fact that cream from sour milk has a high viscosity, or is less fluid, and a smaller proportion of cream is delivered, containing a higher per cent of fat. A slight variation in per cent of fat in cream separated from sweet and sour milk is shown in the following table:

Per cent of acid in Sweet Milk	Per cent of acid in Sour Milk	Per cent of fat in cream separated From Sweet Milk	Per cent of fat in cream separated Sour Milk
.19	.39	41.8	44.8
.19	.39	17.7	17.7
.19	.40	18.6	18.8

Effect of Balanced and Unbalanced Separators on Per Cent of Fat in Cream

A separator that is not kept level, causing a vibration of the bowl, cannot do efficient work. When milk is separated in a balanced bowl the milk is divided into three layers: namely, cream, skim milk, and the separator slime, each finding its respective outlet. If the machine trembles, a portion

of the skim milk and cream is mixed by the vibration of the bowl, and a large per cent of fat is lost in the skim milk. This is shown by the following results:

	Separators	
	Balanced	Unbalanced
Per cent of fat in cream	31.0	28.3
Per cent of fat in skim milk	.03	.17

Rich Cream

The cream separator screw should be set to deliver cream containing from 35 to 45 per cent fat. Cream of this richness has a better keeping quality; it is less bulky to handle, and more skim milk is left on the farm for feeding purposes than when a thin cream is skimmed. Aside from the fact that cream with a high per cent of fat is an economic benefit to the patron, it is also of great importance to the creamery in the manufacture of the best quality of butter, as it allows pasteurization and the use of starters in ripening cream to be carried on with better results.

Patron's Check on Per Cent of Fat in Cream Delivered to Creamery

Any patron can calculate within a few per cent what his cream should test before taking it to the creamery. However, it is necessary to know exactly the per cent of fat in the milk before separation. Assume, for example, 100 pounds of milk testing 3.5 per cent fat, which means 3.5 pounds of butterfat, and assume that from this amount of milk ten pounds of cream are obtained; the test of the cream would then be 35 per cent, provided there was no fat in the skim milk. The following table gives the pounds of cream testing from 20 to 45 per cent to be obtained from 100 pounds of milk testing from 3.3 to 4 per cent:

Test %	20% lbs.	25% lbs.	30% lbs.	35% lbs.	40% lbs.	45% lbs.
3.3	16.5	13.2	11.00	9.43	8.25	7.34
3.4	17.0	13.6	11.33	9.71	8.50	7.56
3.5	17.5	14.0	11.66	10.00	8.75	7.78
3.6	18.0	14.4	12.00	10.28	9.00	8.00
3.7	18.5	14.8	12.33	10.57	9.25	8.22
3.8	19.0	15.2	12.66	10.85	9.50	8.44
3.9	19.5	15.6	13.00	11.14	9.75	8.66
4.0	20.0	16.0	13.33	11.43	10.00	8.88

A test calculated in this way is usually from one-half to one per cent higher than the true test. This is due to the mechanical loss of whole milk and to the loss of fat in skim milk.

Financial Loss in Careless Handling of Separators

The following data taken from the California Experiment Station Bulletin No. 209, shows the possible annual loss of butterfat in skim milk from one cow, where the separator is improperly operated:

Separator Run	% Fat in Skim Milk	Lbs. Loss in Butterfat	Value of Lost Butterfat
Balanced	.03	2.3	\$0.75
Unbalanced	.17	13.0	4.28
Ten turns too high	.029	2.21	.74
Normal speed	.029	2.21	.74
Ten turns too low	.120	9.18	3.03
Twenty turns too low	.210	16.06	5.30
Washed after each sep.	.038	2.98	.96
Washed once daily	.10	7.45	2.77
Large inflow	.145	11.09	3.64
Normal inflow	.028	2.14	.71
Small inflow	.027	2.06	.68
Temp. of milk 90° F.	.022	1.68	.55
Temp. of milk 75° F.	.051	3.90	1.29
Temp. of milk 60° F.	.120	9.18	3.03

The above results are figured by taking 9000 pounds of milk as the yield, and 85 per cent of this amount being skim milk separated, and the value of the butterfat is rated at 33 cents per pound.

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