

SOME FACTORS WHICH INFLUENCE THE FEATHERING OF CREAM IN COFFEE¹

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PLAN OF EXPERIMENTS

Feathering is the flaking or curdling of cream in coffee. This is sometimes troublesome to milk dealers because customers assume that it indicates sourness; and because, although sweet cream when it feathers does not produce a sour taste in the coffee, yet it gives an unpleasing appearance. It is known that sour cream will feather when added to hot coffee, but at times cream that is sweet to the taste will do likewise. From this it may be concluded that there must be factors other than high acidity which affect or influence feathering. With this in mind a number of factors were studied as follows:

Acidity of coffee made by different methods—boiled, percolated, drip.

Use of coffees of different grades—high, medium, low.

Method of mixing cream and coffee—

- (a) Adding cream to coffee without sugar.
- (b) Adding cream to coffee and sugar.
- (c) Adding coffee to cream without sugar.
- (d) Adding coffee to cream and sugar.

Age of cream.

Kind of cream—percentage of butterfat, and whether raw, pasteurized, homogenized, or frozen.

The acidity of the cream was the basic factor for determining the effect which these various other factors had on the feathering of the cream. The acidity was determined as lactic acid by titrating with N/20 NaOH, using phenolphthalein as an indicator. The conclusions are based on results obtained from a total of about 900 different tests.

ACIDITY OF COFFEE

Three different methods of making coffee were tried—boiling, percolating, and dripping.

Boiled.—The coffee was medium ground, 50 grams to 500 cc. of distilled water, boiled for five minutes, filtered, cooled, and made up to 500 cc.

Percolated.—The coffee was medium ground, 50 grams to 500 cc. distilled water, percolated for five minutes, filtered, cooled, and made up to 500 cc.

French drip.—Pulverized coffee, 50 grams to 500 cc. of boiling distilled water poured through the coffee once, filtered, cooled, and made up to 500 cc.

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² Credit is due Geo. B. Taylor, former market milk specialist with this division, for preliminary work in these experiments.

The acidity of the coffees made by these various methods, using brom-thymol blue as indicator, is shown in the following table:

TABLE I.—Acidity of coffee made by various methods

Method.	N/10NaOH required to neutralize 100 cc. of coffee.	Hydrogen-ion concentration.
	Cc.	P_H
Boiled.....	11. 0	4. 9 ²
Percolated.....	11. 5	4. 9 ¹
French drip.....	12. 0	4. 9 ²

There was practically no difference in the acidity of the coffee made by these methods. Because of this fact it was considered unnecessary to run cream tests on coffee made by all three methods. The French drip method was selected for all the experiments. Fifty grams of pulverized coffee were used to 1,000 cc. of water.

GRADE OF COFFEE

Three different grades of coffee of known quality—high, medium, and low—were obtained through the New York office of the Bureau of Chemistry. These three grades and a special brand of coffee purchased on the market were used in experiments on the effect of different grades of coffee on feathering.

The titratable acidity of the different grades, using brom-thymol blue as indicator, was practically the same for all and was as follows:

TABLE II.—Acidity of coffee of different grades

Grade.	N/20 NaOH required to neutralize 100 cc. of coffee.
	Cc.
High.....	12. 0
Medium.....	12. 0
Low.....	12. 5
Special brand.....	12. 5

There was no noticeable difference in the effect of these various grades of coffee on the feathering of the cream, as shown in a total of 120 tests run on each coffee, in which the following grades of cream were used: Raw cream testing 20 per cent butterfat, pasteurized cream testing 20 per cent, pasteurized and homogenized cream testing 20 per cent, and raw cream testing 35 per cent.

METHOD OF MIXING CREAM AND COFFEE

In the remaining experiments the special brand of coffee was used. The average temperature of the coffee at the actual time of mixing the cream with it was about 95° C. Each experiment consisted of—

- (a) Adding cream to coffee without sugar.
- (b) Adding cream to coffee and sugar.
- (c) Adding coffee to cream without sugar.
- (d) Adding coffee to cream and sugar.

Cream always feathered at a lower acidity in method (d)—when the coffee was added to the cream and sugar. (See Tables III to VIII.) This may be attributed to the fact that the sugar in dissolving used moisture from the cream and in so doing precipitated some of the casein present, causing feathering when the hot coffee was added. If the sugar was moistened with a little water before adding the cream, or the sugar was added to the coffee either before or after adding the cream, then the sugar had no effect on the feathering.

In practically all the tests, method (c)—adding the coffee to the cream without sugar—had the least effect on the feathering, i. e., the cream did not feather at so low an acidity when the coffee was added to the cream without sugar. Sugar may be added afterwards without affecting the feathering. (See Tables III to VIII.)

AGE OF CREAM

The effect of age of cream on feathering was determined by aging cream at low temperatures (1° to 2° C.) so as to keep acidity increase at a minimum. Aging cream for 7 to 10 days by this method had no effect on the feathering.

KIND OF CREAM

The richness of the cream had very little effect on the feathering. The richer creams, i. e., those containing a higher percentage of butterfat, feathered at a slightly lower acidity. This was undoubtedly due to the fact that the acidity in the richer creams was more nearly true acid than in the case of the less rich creams, containing more solids not fat, which would affect the titratable acidity. (See Tables III and IV.)

The acidity of all the cream was determined by titrating 10 cc. of the cream with N/20 NaOH, using phenolphthalein as indicator.

Pasteurizing had but slight effect on the feathering. Comparative tests of raw and pasteurized creams showed that the pasteurized creams feathered at a slightly lower acidity than the same cream not pasteurized. (See Tables III, V, and VI.)

Homogenizing greatly affects the feathering of cream. Homogenized cream feathered at a decidedly lower acidity than any that was not homogenized. There were considerable variations in the percentage of acidity at which the homogenized cream feathered, due undoubtedly to the fact that the samples were purchased from different dealers, who probably were using different homogenizing pressures. No information concerning the pressures used was obtained. (See Table VII.) Comparative tests, using different pressures, showed that the higher the pressure at which the cream was homogenized, the lower the acidity at which it feathered. (See Table VIII.)

Freezing the cream had apparently no effect on the feathering; a heavy oily layer would form on the coffee, however.

RESULTS OF EXPERIMENTS

In Tables III to VIII, showing the results of the experimental work, the four methods of mixing the cream and coffee are described as follows: *a* represents adding cream to coffee without sugar; *b* represents adding

cream to coffee and sugar; *c* represents adding coffee to cream without sugar; *d* represents adding coffee to cream and sugar.

TABLE III.—Results of composite tests of raw cream testing 18 and 20 per cent butterfat

Acidity of cream.	Method of mixing cream and coffee.			
	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>
0.225 per cent. . .	No feathering . .	No feathering . .	No feathering . .	Feathering.
0.29 per cent. . .	do	do	do	Do.
0.295 per cent. . .	Trace	Trace	do	Do.
0.315 per cent. . .	Feathering	Feathering	Trace	Do.
0.32 per cent. . .	do	do	Feathering	Do.

TABLE IV.—Results of composite tests of raw cream testing 30 and 35 per cent butterfat

Acidity of cream.	Method of mixing cream and coffee.			
	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>
0.22 per cent. . . .	No feathering . .	No feathering . .	No feathering . .	Feathering.
0.26 per cent. . . .	do	do	do	Do.
0.30 per cent. . . .	Feathering	Feathering	Trace	Do.

TABLE V.—Results of composite tests of pasteurized cream testing 20 per cent butterfat

Acidity of cream.	Method of mixing cream and coffee.			
	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>
0.225 per cent. . .	No feathering . . .	No feathering . . .	No feathering . . .	Feathering.
0.26 per cent. . . .	do	do	do	Do.
0.295 per cent. . .	Feathering	Feathering	Trace	Do.

TABLE VI.—Comparative tests of raw and pasteurized cream testing 30 per cent butterfat

Acidity of cream.	Method of mixing cream and coffee.			
	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>
Raw cream:				
0.23 per cent. . .	No feathering . . .	No feathering . . .	No feathering . . .	Feathering.
0.26 per cent. . .	do	do	do	Do.
0.30 per cent. . .	Feathering	Feathering	Feathering	Do.
Pasteurized cream:				
0.22 per cent. . .	No feathering . . .	No feathering . . .	No feathering . . .	Do.
0.24 per cent. . .	do	do	do	Do.
0.275 per cent. . .	Feathering	Feathering	Trace	Do.
0.295 per cent. . .	do	do	do	Do.

TABLE VII.—Composite tests of homogenized and pasteurized cream testing 20 per cent butterfat

Acidity of cream.	Method of mixing cream and coffee.			
	a	b	c	d
0.125 per cent. . .	No feathering...	No feathering...	No feathering...	Trace.
0.14 to 0.16 per cent.	Trace.....	Trace.....	.....do.....	Feathering.
0.155 to 0.185 per cent.	Feathering.....	Feathering.....	Trace.....	Do.
0.165 to 0.22 per cent.	.....do.....	.....do.....	Feathering.....	Do.

TABLE VIII.—Effect of homogenizing pressure on feathering of raw cream testing 30 per cent butterfat

Acidity of cream.	Method of mixing cream and coffee.			
	a	b	c	d
1,000 pounds pressure:				
0.135 per cent.	No feathering ^a ..	No feathering...	No feathering...	No feathering.
0.145 per cent.	.....do.....	.....do.....	.....do.....	Do.
0.185 per cent.	Feathering.....	Feathering.....	Trace.....	Feathering.
2,000 pounds pressure:				
0.125 per cent.	No feathering...	No feathering...	No feathering...	No feathering.
0.135 per cent.	.....do.....	.....do.....	.....do.....	Feathering.
0.170 per cent.	Feathering.....	Feathering.....	Feathering.....	Do.
3,000 pounds pressure:				
0.135 per cent.	Trace.....	No feathering...	No feathering...	Do.
0.145 per cent.	.....do.....	Trace.....	.....do.....	Do.
0.175 per cent.	Feathering.....	Feathering.....	Feathering.....	Do.
4,000 pounds pressure:				
0.135 per cent.	Trace.....	Trace.....	No feathering...	Do.
0.145 per cent.	Feathering.....	Feathering.....	.....do.....	Do.
0.180 per cent.	.....do.....	.....do.....	Feathering.....	Do.

^a There was no feathering up to 0.190 per cent acid on a sample of the same cream not homogenized.

SUMMARY

In determining the effect of the various factors on the feathering of cream in coffee, the acidity of the cream was taken as the basic factor, because it was present in all cases. It was also the factor having the greatest influence on feathering. Cream having an acidity of three-tenths of 1 per cent tastes sour to most people and will almost invariably feather when added to hot coffee.

The average temperature of the coffee at the time of mixing it with the cream was about 95° C.

The acidity of the coffee made by different processes, namely, boiled, percolated, and dripped, was practically identical. The hydrogen-ion determinations were respectively as follows: P_H 4.92, 4.91 and 4.92. This excluded the method of preparation as having any effect on feathering.

The acidity of coffee made by the drip method from high, medium, and low grades of known quality, and from a special brand of unknown quality but supposedly high grade, was practically the same. There was no noticeable difference in the effect of the various grades of coffee on the feathering of the cream.

Each experiment consisted of—

- (a) Adding cream to coffee without sugar.
- (b) Adding cream to coffee and sugar.
- (c) Adding coffee to cream without sugar.
- (d) Adding coffee to cream and sugar.

Of these four factors, adding the coffee to the cream and sugar had the greatest effect on the feathering; in other words, the cream feathered at a much lower acidity in (d) than it did in either (a), (b), or (c). Adding the coffee to the cream without sugar, (c), had the least effect on the feathering, although the advantage as compared with (a) and (b) was very slight.

Aging cream for from 7 to 10 days at a low temperature (1° or 2° C.) so as to keep acidity increase at a minimum, had no effect on the feathering.

The richness of the cream had very little effect on the feathering, though the richer cream (higher in percentage of butterfat) feathered at a slightly lower acidity. This was undoubtedly due to the fact that the titratable acidity in the richer cream was more nearly true acid.

Pasteurizing had but little effect on the feathering; however, there was a tendency for pasteurized cream to feather at a slightly lower acidity than the same cream not pasteurized.

Homogenization greatly affected the feathering of cream, causing it to feather at a decidedly lower acidity than any of the creams not homogenized. The greater the homogenizing pressure used, the lower the acidity at which the cream feathered.

Freezing the cream had no effect on feathering. A heavy, oily layer always appeared on the coffee, however, when cream that had been frozen was added.

The main factors causing feathering of cream in coffee are: High acidity; homogenization; adding hot coffee to cream and sugar. Acidity and homogenization are chiefly commercial problems. It is well to homogenize only cream of very low acidity if it is to be used in coffee, and to keep the homogenizing pressure as low as possible. Adding hot coffee to cream and sugar is a household and restaurant problem. It is well not to mix the cream and sugar before adding the hot coffee.