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EFFECT OF COMPOSITION ON THE PALATABILITY OF ICE CREAM.

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FACTORS AFFECTING QUALITY OF ICE CREAM.

It has often been said of ice cream that its palatability would be impaired by making it rich in milk solids and sugar, particularly if the fat content reached or exceeded 14 per cent. The correctness of such statements has generally been questioned, although no one has ever shown in a systematic way the actual rate at which desirability may be altered by using various percentages of fat, sugar, and other constituents in the manufacture of ice cream. Manufacturers have already obtained much information of this character by experimenting with different formulas in their factories and comparing the results. Many soon found the quality of their product depended on three main factors: First, the quantity of milk solids the ice cream contained (composition); second, the initial quality of each ingredient; and third, workmanship.

In an effort to show how important the first factor, composition, may be to the quality of ice cream, several experiments have been made to determine what would constitute a relatively good proportion of each of the three principal classes of solids, namely, fat, cane sugar, and milk solids not fat, in the mix. A similar experiment was also made with gelatin as an ingredient in ice cream.

EXPERIMENTAL WORK.

TREATMENT OF MIXES AND CONDITIONS OF WHIPPING AND FREEZING.

The size of each mix made for these experiments was 25 pounds. The treatment given to each set of mixes was always the same, although it was purposely varied on different sets in the same experiment. Usually one set of mixes was sufficient for at least two days' sales. The ice cream was sold to department employees during the noon lunch period, between 12 and 12.30.

Some mixes were pasteurized and aged for from 24 to 96 hours. Others were homogenized and aged for varying periods before freezing, while some sets of mixes were frozen a few hours after they were made up. The temperature at which each set of mixes was aged also varied.

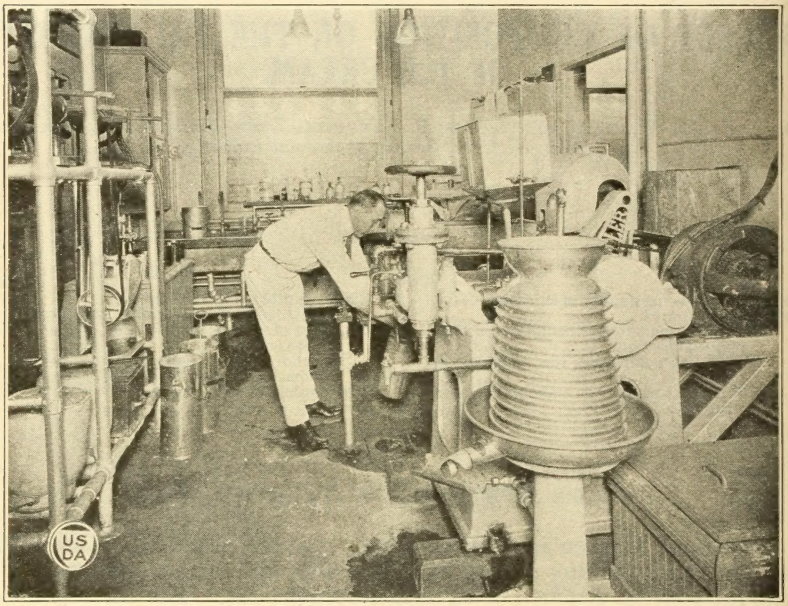

FIG. 1.—Ice-cream laboratory where experiments are made under conditions similar to those in commercial manufacture.

The whipping and freezing was done in a horizontal 24-quart brine freezer. The brine temperature varied from 3° F. on some days to 15° F. on other days, with the speed of the freezer kept fairly constant. The ice cream from each mix was hardened in a 3-can cabinet packed with crushed ice and salt. The amount of inflation (swell) obtained in the different grades of ice cream ranged from 42 to 93 per cent.

The ice cream was always hardened in and dispensed from the same cabinet, so that the temperature and other conditions which might affect it were practically alike during the time it was offered for sale.

METHOD OF COMPARING THE DIFFERENT ICE CREAMS.

The difference obtained in the ice creams made in these experiments was measured by means of a market where about 50 daily purchasers had an opportunity to choose from three different kinds of ice cream. Their choice was then taken to represent the degree of desirability of each kind offered. A nominal flat charge was made for each daily portion of ice cream. No attempt was made to charge according to a sliding scale based on the composition of the ice cream, because this would disclose the difference in quality and defeat the main purpose of the test.

This is a new method of measuring the desirability of ice cream, and we believe it has many advantages over the score-card method.

FIG. 2.—Three different kinds of ice cream were sold, with an opportunity to choose the kind preferred on the following day or days.

Since it is not difficult to obtain the opinion of a much larger number of people with this method, it is probably more reliable than the score-card method. Instead of submitting a sample of each different kind or batch of ice cream to be scored with a score card, we first classified the experiments relative to the ingredients and limited the number of ice creams in each experiment to three, so that the major differences would be in the same general direction in each group of experiments. Then while the treatment given the three ice creams and the conditions of freezing and hardening were kept the same, the ice creams were placed on sale for a period of 10 or more days.

The ice cream was sold daily to the purchasers, who did not know what variation had been made in the composition. Each purchaser was provided with a weekly coupon ticket, entitling the recipient to one-half pint each day.

The purchasers were given a sample of each kind of ice cream on the first day in order to compare the three kinds, and were informed

that on the following day or days they would be given their choice of the three kinds of ice cream. Sometimes comparison of samples was made twice a week, but usually only once a week. The purchasers, however, could change from one kind of ice cream to another at will.

EFFECT OF FAT CONTENT ON PALATABILITY OF ICE CREAM.

In this experiment a comparison was made of three ice-cream mixes that contained 18, 15, and 12 per cent of fat, while the other constituents and methods of manufacture remained the same. These three mixes, designated as F, D, and E, respectively, were sold on each of four consecutive days for three continuous weeks.

The total number of sales for the period covered was 551, and the number of persons (adults) who purchased was 67. Of this number

FIG. 3.—Their second plates in the experiment of "eating at will." Three platefuls were frequently eaten.

316 sales were made to 27 persons, as shown in Table 1, who purchased the ice cream regularly each week during the 3-week period.

TABLE 1.—*Preference for different proportions of fat in ice cream by 27 purchasers on 4 days in each of 3 consecutive weeks.*

Mix.	Times chosen by each purchaser.															
F, 18 per cent fat	11	11	4	11	11	2	10	10	12	12	10	10	11	7	9	12
D, 15 per cent fat	0	0	4	0	1	4	2	0	0	0	0	0	0	2	2	0
E, 12 per cent fat	0	0	4	0	0	6	0	2	0	0	2	2	0	2	1	0

	Times chosen by each purchaser.											Total sales.	
												Number.	*Per cent.*
F, 18 per cent fat	11	8	10	12	9	9	12	6	11	11	7	259	82.0
D, 15 per cent fat	0	4	2	0	2	0	0	5	0	0	5	33	10.4
E, 12 per cent fat	0	0	0	0	1	2	0	0	1	1	0	24	7.6
Total												316	100.0

The records of the 316 sales in the table show that 82 per cent were of ice cream containing 18 per cent fat (mix F), and 10.4 per cent of the sales were of ice cream containing 15 per cent fat (mix D). This left only 7.6 per cent of the sales in which purchasers favored ice cream containing 12 per cent fat (mix E). The sales not recorded in the table showed preferences very much the same, 15 per cent being in favor of mix E, 14 per cent in favor of mix D, and 71 per cent in favor of mix F.

These figures show conclusively that the rich ice cream was preferred by a large majority of the purchasers.

EFFECT OF SUGAR ON PALATABILITY OF ICE CREAM.

To determine the effect of sugar on the desirability of ice cream, a comparison was made of three ice-cream mixes containing 19, 16, and 13 per cent of cane sugar. These mixes, designated as G, H, and I, respectively, contained 14 per cent of fat, and the methods of manufacture were practically the same in each case. The ice cream was sold on 10 different days during three consecutive weeks. The daily sales are recorded in Table 2.

TABLE 2.—*Preference for varying proportions of sugar in ice cream by 82 purchasers on 10 different days during 3 consecutive weeks.*

Mix.	Days.										Total sales.	
	1	2	3	4	5	6	7	8	9	10		
											Number.	*Per cent.*
G, 19 per cent sugar	28	28	27	27	23	26	25	25	29	34	272	61.4
H, 16 per cent sugar	10	10	9	9	13	15	15	15	17	13	126	28.4
I, 13 per cent sugar	5	5	8	8	7	5	3	3	0	1	45	10.2
Total	----	----	----	----	----	----	----	----	----	----	443	100.0

The total number of sales for the period covered was 443 and the number of persons who purchased was 82. The records of these 443 sales show that 61.4 per cent of the choices were made in favor of ice cream containing 19 per cent sugar (mix G); 28.4 per cent were made in favor of ice cream containing 16 per cent sugar (mix H); and 10.2 per cent were in favor of ice cream containing 13 per cent sugar (mix I). In other words, about 90 per cent of the sales indicated a preference for ice cream containing 16 per cent or more of sugar.

EFFECT OF MILK SOLIDS NOT FAT ON PALATABILITY OF ICE CREAM.

In the third experiment a comparison was made of three ice-cream mixes containing 12, 9, and 6 per cent of milk solids not fat, the other constituents (fat, 10 per cent; sugar, 14 per cent; and gelatin 0.5 per cent) and the methods of manufacture being practically the same. These mixes, designated as B, C, and A, respectively, were sold on 30 different days during a period of six consecutive weeks. The daily sales are recorded in Table 3.

TABLE 3.—*Preference for different proportions of milk solids not fat in ice cream by 128 purchasers on 30 days in 6 consecutive weeks.*

Mix.	Total sales.	
	Number.	*Per cent.*
B, 12 per cent milk solids not fat	665	56.1
C, 9 per cent milk solids not fat	305	25.7
A, 6 per cent milk solids not fat	215	18.2
Total	1,185	100.0

The records of these 1,185 sales show that 56.1 per cent of the choices were made in favor of the ice cream containing the greatest quantity (12 per cent) of milk solids not fat (mix B); 25.7 per cent were in favor of the ice cream containing 9 per cent milk solids not fat (mix C); and 18.2 per cent were in favor of ice cream containing 6 per cent milk solids not fat (mix A). This means that over 80 per cent of the sales indicated a preference for ice cream containing at least 50 per cent more milk solids not fat than is often found in commercial ice cream, i. e., a preference for 9 per cent or more, instead of about 6 per cent, in ice cream testing 10 per cent fat.

About two-thirds of the total sales in this test were to persons who ate the ice cream for prolonged periods. Thus, 11 persons purchased for 3 consecutive weeks, 12 for 4 weeks, 9 for 5 weeks, and 7 for 6 weeks.

The percentages of preference for the different amounts of milk solids not fat shown by these 39 different persons are given in Table 4. There was not much difference in the results as compared with Table 3.

TABLE 4.—*Preference for different proportions of milk solids not fat in ice cream by 39 persons purchasing it during periods of 3 to 6 consecutive weeks.*

Mix.	Total sales.	
	Number.	*Per cent.*
B, 12 per cent milk solids not fat	438	53.3
C, 9 per cent milk solids not fat	226	27.5
A, 6 per cent milk solids not fat	158	19.2
Total	822	100.0

EFFECT OF GELATIN ON PALATABILITY OF ICE CREAM.

In the fourth experiment a comparison was made of three ice-cream mixes containing 0, 0.5, and 1 per cent of medium-grade gelatin, with the other constituents and methods of manufacture kept the same. These mixtures were designated as K, M, and L, respectively. They were prepared on nine different occasions, and each mix was pasteurized and homogenized. The mixes were then held for varying periods before freezing, ranging from one to five days. The number of sales made on 10 days during the three consecutive weeks was 623, these sales being made to 66 persons. The results are given in Table 5.

TABLE 5.—*Preference for varying proportions of gelatin in ice cream by 66 persons during 10 days in 3 consecutive weeks.*

Mix.	Total sales.	
	Number.	*Per cent.*
L, 1 per cent gelatin	394	63.2
M, 0.5 per cent gelatin	86	13.8
K, no gelatin	143	23.0
Total	623	100.0

Table 5 shows that in 394, or 63.2 per cent, of the sales the purchasers asked for the ice cream that contained 1 per cent of gelatin (mix L); in 143 sales, or 23 per cent, they asked for the ice cream that contained no gelatin (mix K); and in 86, or 13.8 per cent, they asked for the ice cream that contained 0.5 per cent of gelatin (mix M). This shows that when preference was given to ice cream made without gelatin or with gelatin, the ratio was a little less than 3 to 1 in favor of the product with gelatin.

INFLUENCE OF FAT CONTENT ON QUANTITY EATEN.

The fat content of ice cream does not seem to have a great effect on the quantity of ice cream a person will eat, except, perhaps, when it is very rich. A test made with two ordinary grades of ice cream, one containing 10 per cent and the other 15 per cent fat, showed that the average adult person consumed 341 grams (1.2 pints) of the 10 per cent cream and 317 grams (1.12 pints) of the 15 per cent cream when given all he would eat.

The test was made by serving groups of from five to seven persons from a weighed can of ice cream. After they had eaten all they wanted, the can was reweighed, and the total amount consumed was divided by the number of persons eating. This was done at 12 different times, 6 times with ice cream containing 10 per cent fat and 6 times with ice cream containing 15 per cent fat. The time of this experiment was in March and April, 1921.

TABLE 6.—*Quantity of ice cream of varying fat content consumed on 12 different days by groups of 5 to 7 persons eating at will.*

Test No.	Number of persons.	Quantity consumed.		Test No.	Number of persons.	Quantity consumed.	
		Total.	Average per person.			Total.	Average per person.
Ice cream containing 10 per cent fat:		*Grams.*[1]	*Grams.*[1]	Ice cream containing 15 per cent fat:		*Grams.*[1]	*Grams.*[1]
1	7	2,100	300	7	7	2,177	311
2	7	1,981	283	8	7	1,848	264
3	7	2,520	360	9	7	1,946	278
4	5	2,390	478	10	6	2,226	371
5	5	2,380	476	11	5	1,860	372
6	7	1,596	228	12	5	1,670	334
Total and average	38	12,967	341	Total and average	37	11,727	317

[1] One pint of ice cream, weighing 5 pounds per gallon, equals 283 grams.

BEST COMBINATIONS OF ICE-CREAM INGREDIENTS.

A question frequently asked is, What combination will produce the best quality of ice cream? It has been shown that a preference is usually given to the ice creams richest in fat, sugar, and milk solids not fat, but no attempt was made in our experiments to ascertain the optimum combination of all these ingredients to produce the best product. To do this would require a very large number of tests. The results, however, might prove beneficial in establishing one type of commercial ice cream instead of the two types we now have, i. e., one rich in fat and the other rich in milk solids not fat. This is a matter that must be left for further consideration.

SUMMARY.

The effect of the composition of ice cream on its palatability was tested by selling ice cream made in different ways to the same persons from day to day, serving it in such a manner that the buyers would show their preference, and noting the kinds preferred and the extent to which they were preferred.

Experiments with varying proportions of fat, sugar, milk solids not fat, and gelatin in ice cream show that there is a decided preference by consumers for the richest, sweetest, and firmest products. The following figures express the results obtained:

Butterfat.—The effect of fat on the palatability of ice cream is indicated by preference in 82, 10.4, and 7.6 per cent of the cases in favor of ice cream containing 18, 15, and 12 per cent of fat, respectively.

Sugar.—The effect of sugar on the palatability of ice cream is indicated by preference in 61.4, 28.4, and 10.2 per cent of the cases in favor of ice cream containing 19, 16, and 13 per cent sugar, respectively.

Milk solids not fat.—The effect of milk solids not fat on the palatability of ice cream containing 10 per cent of fat is indicated by preference in 55.6, 25, and 18.6 per cent of the cases in favor of ice cream containing 12, 9, and 6 per cent of milk solids not fat, respectively.

Gelatin.—The effect of gelatin on the palatability of ice cream containing 14 per cent fat is indicated by preference in 63.2, 13.8, and 23 per cent of the cases in favor of ice cream containing 1, 0.5, and 0 per cent of gelatin, respectively.

Experiments on the influence of fat content on the acceptability of ice cream shows that the amount of ice cream eaten containing 10 per cent and of that containing 15 per cent of fat averages practically the same.

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