

Effect of Aging Treatment
On the Bacterial Count of
Ice-Cream Mixes.

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of Ice Cream Mixes**

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This investigation was undertaken to determine whether the aging temperature of 68° F., considered desirable when gelatin is used in the manufacture of ice cream, has an unfavorable effect on the bacterial count of the product.

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EFFECT OF AGING TREATMENT ON THE BACTERIAL COUNT OF ICE CREAM MIXES

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INTRODUCTION

It is a general belief in the ice cream industry that after the mix has been homogenized it must be cooled at once to a temperature of approximately 40° F. in order to avoid marked increases in bacterial growth during the aging period. However, to our knowledge, there is no experimental evidence to support this general assumption. No doubt aging an ice cream mix above 50° F. for 24 hours would result in a marked bacterial increase. Olson and Fay (1) reported that the aging, without agitation, of improperly cooled mix (65° F.) in cans in a cold room (38° F.), resulted in a marked increase in bacterial content in 24 hours.

The question remains as to whether or not an increase in bacteria would occur if a pasteurized mix were held for a relatively short time at a temperature above 50° F. The comparatively recent advocacy of a reduction of the aging period from 24 hours, or longer, to 2 to 4 hours makes it appear more feasible to use higher aging temperatures.

In previous publications (2, 3) by the senior author, it was shown that when an ice cream mix contained gelatin the efficiency of this ingredient was increased by aging the ice cream mix for 4 hours at 68° F., regardless of whether or not this was followed by aging at a lower temperature. The efficiency of the gelatin was increased to such an extent that the gelatin could be reduced approximately one-fourth without impairing the quality of the finished product. Also, a limited number of trials showed that aging a pasteurized mix at 68° F. for 2, 4, and 6 hours had no apparent effect on the bacterial growth, pH, or titratable acidity, which would be of any commercial significance.

The purpose of the work herein reported was: to check the results previously reported concerning the effect on the bacterial count of aging ice cream mixes at 68° F. for 6 hours; to study the effect on the bacterial count of aging ice cream mixes at 68° F. for 6 hours, followed by aging at 38° F. for 18 hours; to determine at what time significant increases in bacterial count occur in ice cream mixes held at 68° F.

PLAN OF EXPERIMENT

The general plan of this study was to subject both pasteurized and raw ice cream mixes to the following aging treatments, and compare the total bacterial counts of the mixes so treated:

- (1) Unaged.
- (2) Held 6 hours at 38° F.
- (3) Held 6 hours at 68° F.
- (4) Held 24 hours at 38° F.
- (5) Held 6 hours at 68° F., plus 18 hours at 38° F.

Also, pasteurized and raw mixes were held at 68° F. for varying periods of time in order to determine when the bacterial counts start to increase. Although raw mixes are rarely used in commercial practice, they were included in this experiment for comparison with pasteurized mixes, in order to obtain if possible some information as to why the bacterial content of the pasteurized mixes does not increase markedly with holding at 68° F. for 6 hours.

Experimental Methods

Preparation of the pasteurized mixes. Most of the ice cream mixes were prepared and processed in the college creamery. A few raw and processed mixes were obtained from nearby commercial ice cream plants, the raw mixes being subsequently pasteurized at the college creamery. The mixes represented a variety in formulas, ingredients, and size of batch. All of the ingredients, with the exception of the flavoring material, were mixed, pasteurized, and homogenized together.

Pasteurization. The ice cream mixes were pasteurized in most instances at 145° to 150° F. for 30 minutes. In some instances other combinations of temperature and time were used in order to secure higher initial bacterial counts.

Homogenization. Most of the mixes were homogenized at 2500 pounds pressure per square inch, at the temperature of pasteurization. In most instances the homogenizer was thoroughly washed and sterilized before being used. In some instances, in order to secure higher initial bacterial counts, the homogenizer was not thoroughly cleaned.

Cooling and Aging. Immediately after homogenization the mixes were cooled to their respective aging temperatures either over the surface cooler, or in sterile flasks set in cold brine. Aging was done in sterile flasks which were placed in either a thermostatically controlled water bath or a thermostatically controlled temperature box. Samples from these flasks were plated at various times during the aging period.

Preparation of the unpasteurized mixes. The mixes used represented a variety in formulas, ingredients, and size of batch. All of the ingredients, with the exception of the flavoring material were mixed, heated to approximately 100° F., and immediately homogenized at 2500 pounds pressure per square inch. After homogenization the unpasteurized mixes were treated in the same manner as the pasteurized mixes.

Bacteriological methods. Samples for the bacteriological analyses were weighed, and the number of bacteria per gram of sample were determined by the agar plate count method recommended by the American Public Health Association (4).

EXPERIMENTAL RESULTS

Effect of Aging Treatment on the Bacterial Count of Pasteurized Ice Cream Mixes

Table 1 gives the original data obtained when pasteurized ice cream mixes were subjected to various aging treatments. It will be observed that the bacterial counts of the raw mixes covered a wide range, the highest being 58,000,000 per gram and the lowest 1,000. When the counts before and after pasteurization

TABLE 1. EFFECT OF AGING TREATMENT ON THE BACTERIAL COUNT OF PASTEURIZED ICE CREAM MIXES.

Mix No.	Bacterial Count of Mixes before Pasteurization	Bacterial Count of Pasteurized Mixes				
		Before Aging	Held 6 Hours at 38° F.	Held 6 Hours at 68° F.	Held 24 Hours at 38° F.	Held 6 Hours at 68° F. plus 18 Hours at 38° F.
1	2,100	60,000			75,000	70,000
2		1,400	2,300	2,000	4,000	3,000
3	11,000	8,000	6,200	7,000	9,000	8,000
4	22,000	2,000	3,200	2,500	2,400	2,100
5	16,000	5,000	3,000	3,200	3,200	3,000
6	8,500	6,400			2,500	3,100
7	9,000	4,000			2,100	1,800
8	8,000	6,000			3,500	2,700
9	8,000	1,200			700	1,000
10	240,000	5,100	4,700	5,300	5,000	15,000
11	1,090,000	18,000			12,000	14,000
12	13,800	11,000	12,700	13,100	12,800	12,400
13	58,500,000	17,600	17,100	16,800	12,100	11,400
14	10,000	27,000	23,200	38,000	23,000	24,000
15	23,000	10,000	15,400	14,700	4,900	7,600
16	620,000	9,800	3,000	9,400	4,700	17,900
17	300,000	44,000	10,600	26,000	45,000	29,000
18	55,000	4,500	3,300	4,000	7,500	4,500
19	5,400	1,300	1,400	1,700		
20	150,000	750		650	800	
21	29,600	9,250		10,400	6,650	
22	10,400	1,750	1,850	1,950	1,600	1,600
23	143,500	24,500	32,000	42,000	24,000	24,000
24	3,500	3,150	2,750	1,950	1,650	2,050
25	1,000	650	500	950	1,250	1,400
26	120,000	2,300	2,000	1,600	1,550	1,450
27	11,000,000	90,000	97,000	98,000	92,000	91,000
28	1,500,000	240,000	170,000	181,500	165,000	177,000
29	16,000,000	4,000	3,000	5,000	4,100	6,500
30	1,700,000	39,000	110,000	53,000	47,000	65,000
31		50,000	42,000	51,400		
32		10,500	10,000	12,000		
33		10,300	8,900	10,000		
34		15,300	10,500	10,900		
35		1,170,000	1,015,000	1,110,000		
36		4,100	3,700	3,700		

are compared, the expected decrease is observed. However, in a few instances the pasteurized mix had a higher count than the raw mix, due, no doubt, to recontamination of the mix from the homogenizer.

Table 2 contains a summary of the data given in Table 1. The 36 mixes are classified on the basis of initial bacterial count, and comparisons of final bacterial count made on the bases stated in headings I, II, and III of the table. Naturally there is some error inherent in the technic employed; for this reason all counts falling within 15 per cent of the control count for the same sample are considered "the same," counts more than 15 per cent above the control count are considered "higher," and counts more than 15 per cent below the control count are considered "lower." This procedure for interpreting the data was followed throughout the

experiment. The "initial count" refers to the count obtained on the unaged mix immediately after homogenization. It will be noted that the total number of trials for each separate comparison does not equal 36. This was due, not to the omission of data, but to the fact that platings were not made of every sample each time.

In comparison I, slightly more than one-third of the cases showed a higher bacterial count; in comparison II, one-third of the cases were higher; while in comparison III, slightly less than one-third of the cases were higher. When analyzing the cases which showed an increase, it was found that in no instance did the total count go above the maximum bacterial count tolerated by those states which have a bacterial standard for ice cream. The results given in Tables 1 and 2 show that a pasteurized ice cream mix may be aged for 6 hours at 68° F., whether followed by a low-temperature aging period or not, without an increase in bacteria which would be of any commercial significance.

TABLE 2.--EFFECT OF AGING TREATMENT ON THE BACTERIAL COUNT OF ICE CREAM MIXES.

Summary of Data on Pasteurized Mixes									
Classification of Mixes by Initial Bacterial Count	COMPARISON I. Mixes aged 6 hours at 68° F. Controls aged 6 hours at 38° F.			COMPARISON II. Mixes aged 6 hours at 68° F. plus 18 hours at 38°. Controls aged 24 hours at 38°			COMPARISON III. Mixes aged 6 hours at 68° F. plus 18 hours at 38°. Controls aged 6 hours at 68°.		
	Higher	Lower	Same	Higher	Lower	Same	Higher	Lower	Same
2,500 or less	2	2	2	1	1	4	2	2	1
2,501—5,000	2	1	2	2	1	2	1	0	3
5,001—10,000	1	0	3	4	1	1	2	1	1
10,001—50,000	5	1	4	2	1	4	1	3	2
Over 50,000	0	0	3	0	0	3	0	0	2
TOTALS	10	4	14	9	4	14	6	6	9
Summary of Data on Unpasteurized Mixes									
TOTALS	5	0	0	5	0	0	3	0	2

The Effect of Prolonged Aging at 68° F. on the Bacterial Count of a Pasteurized Ice Cream Mix

The data in the preceding experiment showed that a pasteurized ice cream mix may be held for 6 hours at 68° F. with no significant increase in bacterial count. The present experiment was undertaken to determine how long the mix can be held at 68° F. before the bacterial count begins to increase. Pasteurized mixes were held at 68° F. and platings made at various intervals up to 24 hours, with results shown in Table 3. Bacterial counts when the mixes were aged at 38° F. are included for comparison. The unaged mixes served as controls.

TABLE 3.--EFFECT OF LENGTH OF AGING PERIOD ON PASTEURIZED MIXES.

Mix No.	Bacterial Count of Mixes before Pasteurization	Bacterial Count of Pasteurized Mixes										
		Before Aging	Aged at 68° F.						Aged at 38° F.			
			2 Hours	4 Hours	6 Hours	10 Hours	12 Hours	24 Hours	6 Hours	12 Hours	24 Hours	
1		50,000	52,000	50,500	51,400					42,000		
2		10,500	10,000	11,500	12,000					10,000		
3		10,300	8,300	11,700	10,000					8,900		
4		15,300	18,700	17,000	10,900					10,800		
5		1,170,000	1,220,000	1,516,000	1,110,000					1,015,000		
6		4,100			3,700					3,700		
7	5,400	1,300	1,400	1,500	1,700	1,500	2,100				1,400	
8	150,000	750			650	750			13,000			800
9	29,600	9,250			10,400		10,650	196,000				6,650
10	10,400	1,750			1,950	1,600	1,450	155,000				1,600
11	143,600	24,500			42,000	34,000	102,500	4,000,000				24,000
12	3,500	3,150			1,950	3,500		55,000				1,650
13	1,000	650			950		5,700	470,000				1,250
14	120,000	2,300			1,600		6,500	40,000				1,550
15	11,000,000	90,000			98,000		138,000	94,500				92,000
16	1,500,000	240,000			181,500		267,000	1,250,000				165,000
17	16,000,000	4,000			5,000	7,000	7,000	60,600				4,100
18	1,700,000	39,000			53,000	79,000	105,000	2,400,000				47,000

No definite increase in bacterial count occurred up to 10 hours. Of the mixes held for 10 hours, 3 showed an increase and 4 were the same. After 12 hours, the number of organisms increased in 7 cases, decreased in 1 case, and remained the same in 2 cases. In all but one case the bacterial count showed a marked increase after 24 hours at 68° F. The results obtained in this experiment indicate that when a pasteurized mix is held at 68° F., a definite increase in bacterial count does not occur until after the tenth hour.

Effect of Aging Treatment on the Bacterial Count of Unpasteurized Ice Cream Mixes

Although the majority of commercial ice cream mixes are pasteurized, unpasteurized mixes were used in this experiment for comparison. The data are given in Table 4 and summarized in Table 2. Both high and low count mixes were used.

TABLE 4.--EFFECT OF AGING TREATMENT ON THE BACTERIAL COUNT OF
UNPASTEURIZED MIXES.

Before Aging*	Held 6 hours at 38° F.	Held 6 hours at 68° F.	Held 12 hours at 68° F.	Held 24 hours at 68° F.	Held 24 hours at 38° F.	Held 6 hours at 68° F. plus 18 hours at 38° F.
14,000	13,500	21,200	52,000	3,500,000	16,300	24,000
1,400,000	1,500,000	7,000,000	50,000,000	470,000,000	1,460,000	12,000,000
270,000	310,000	400,000	3,800,000	50,000,000	336,000	550,000
16,000,000	15,600,000	29,000,000	51,000,000	84,000,000	25,000,000	29,000,000
1,700,000	2,100,000	9,000,000	38,000,000	123,000,000	1,700,000	22,000,000

*After Homogenization.

Table 4 shows that when a raw mix is held at 68° F., a definite increase occurs after 6 hours; and this increase, as would be expected, becomes more marked after 12 and 24 hours. The summary in Table 2 indicates clearly that the bacterial counts of raw mixes aged at 68° F., whether followed by low-temperature aging or not, are definitely higher than the bacterial counts of the control mixes aged at 38° F.

GENERAL DISCUSSION

It has been generally assumed that if an ice cream mix is not cooled immediately after homogenization to approximately 40° F., substantial increases in bacteria will occur. In a previous study (3) as well as in this study, it has been shown that pasteurized ice cream mixes may be aged for 6 hours at 68° F. with no marked increase in bacterial count. In all probability the effect of temperature shock on the organisms and also the type of organisms surviving pasteurization are chiefly responsible for the absence of any marked increase in bacteria when a pasteurized mix is held at 68° F. for 6 hours or even for 10 hours.

Throughout this experiment most of the mixes were handled so as to prevent recontamination after pasteurization. In some preliminary experiments, how-

ever, where pasteurized mixes were recontaminated with lactic acid organisms after cooling to 68° F., it was found that the bacterial count increased as much as 600 per cent when these mixes were held for 6 hours at 68° F., as compared with identical mixes held for 6 hours at 38° F. Therefore, in all probability, a pasteurized mix recontaminated after cooling would show a marked increase in bacteria after being held 6 hours at 68° F. This point should not be considered an objection to short-time aging at 68° F., as it is not good practice in ice cream making to permit recontamination of the mix after pasteurization.

In a previous study (3) it was shown that by aging ice cream mixes for 4 hours at 68° F., the efficiency of the gelatin was increased enough so that the gelatin content could be reduced one-fourth without impairing the quality of the ice cream. Since no objectionable increase in bacteria occurs when the mix is held at 68° F. for 6 hours, or in some cases for 10 hours, the ice cream manufacturer can increase the efficiency of the gelatin in the mix by aging at 68° F. and yet have at least 2 hours as a margin of safety from a detrimental increase in bacteria.

SUMMARY

1. The aging of pasteurized ice cream mixes for 6 hours at 68° F., whether followed by aging for 18 hours at 38° F. or not, did not result in a significant increase in the number of bacteria present.
2. When a pasteurized ice cream mix was aged for 24 hours at 68° F., a definite increase in the bacterial count did not occur until after the tenth hour.
3. The aging of an unpasteurized mix for 6 hours at 68° F., whether followed by aging for 18 hours at 38° F. or not, resulted in a material increase in the number of bacteria present.
4. The aging of a mix for 24 hours at 38° F. did not result in a material increase in the number of bacteria present, which agrees with previous findings.

LITERATURE CITED

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