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A STUDY OF SOME COMMERCIAL ICE CREAM IMPROVERS

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HISTORICAL

Very little research work has been done relative to any beneficial effects of ice cream improvers upon the quality of ice cream; however, several articles have appeared in ice cream journals on ice cream improvers. Without exception these articles were written from a theoretical viewpoint and without the aid of any experimental data. The conclusions brought forth in these articles would tend to materially increase the sale of these improvers.

W. P. Abel (1) gave a talk before the Pacific Association of Ice Cream Manufacturers in which he cites the following conclusions: "The day of better ice cream, of richer flavors, and better texture as produced by improvers is here. They do improve and are entitled to your consideration." This remark was made before a group of men interested in the manufacture of ice cream yet he cites no exeprimental data to show how ice cream is improved or how much effect "improvers" bring about.

E. H. Parfitt (2) wrote an article on ice cream improvers in the November, 1922, issue of "The Ice Cream Trade journal," in which he summarizes his conclusions as follows: "We may say that the action of ice cream improvers is caused by the enzyme they contain, rennet or pepsin, mixed with milk sugar, corn starch, or other ingredients. Their purpose is to eliminate the time necessary for aging the mix and if the directions of the manufacturer are followed success is obtainable." No data accompanied this article to show whether or not his conclusion was based on any actual tests made.

Another article by M. W. Woldenberg (3) in the November, 1923, issue of the "Ice Cream Review," shows the following conclusions: "That improvers have their place in the manufacture of ice cream is shown by the fact that reasonable claims made by manufacturers of improvers can scientifically be substantiated. Their value to ice cream manufacturers is not only apparent where there is no time for aging, but also in the work which they accomplish in a pasteurized or homogenized mix. Reducing as they do the time necessary to produce the desired viscosity, they are invaluable to those who believe in efficiency, standardization, and progressiveness." This article also had no scientific or practical experiments to prove this statement.

Three years have elapsed since these articles were written and many

ice cream makers have discontinued the use of improvers because the results obtained were apparently unsatisfactory.

P. H. Tracy (4) in an address before the Oklahoma Association of Ice Cream Manufacturers in 1924, gave some information relative to the effect of ice cream improvers on the shrinkage of ice cream. The specific data on this experimental work has, as yet, not been published but he seems to think from the available data that the use of certain improvers in ice cream may result in the ice cream pulling away from the sides of the can and sinking in the can. He further explains this condition by the fact that when rennet is added to milk it changes the casein to paracasein, which combines with the calcium salts to form an insoluble casein.

PURPOSE OF WORK

Since 1918 as many as thirty different brands of improvers have been offered to the trade, some of these have been entirely discontinued and others are being manufactured to take their place.

It was the purpose of this work to determine by practical experiments, the effect on the ice cream of some of the leading improvers and from this data to attempt to determine whether or not ice cream improvers have a place in the manufacture of commercial ice cream as has been claimed for them.

This information is of two fold importance; first, if "improvers" fail to improve the quality of ice cream, why should the manufacturers spend thousands of dollars each year to determine whether this new product is of material value? Second, if "improvers" do improve the quality of ice cream, then the use of this product should be recommended. A detailed discussion of ice cream improvers and the experimental results which were obtained will be found in the following report.

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PART I.

PLAN OF EXPERIMENTAL WORK

General Explanation

Because of the large number of formulas by which ice cream can be made, it was decided to run two series of experiments.

The first series consisted of three different mixes; namely, thirty-two and one-half percent total solids, thirty-four percent total solids, and thirty-six percent total solids. These mixes were processed and handled as nearly in the same manner as possible. The second series consisted of the same mixes as the first and treated in the same manner, with the exception of not being viscolized. All the mixes were made of the same ingredients; namely, sweet cream, sweet milk, sugar, gelatine, and vanilla extract.

Each mix was divided into eleven equal lots. These lots were again divided into two equal parts which made a duplicate test for each sample of improver. The first lot was used as a control and a different kind of improver was added to each of the other ten. Before the improvers were added the viscosity and acidity of each lot was determined.

Table I.—Mixes Used in Experiments

Series 1.

Viscolized—

Mix Number	Number of Trials	Percent Fat	Percent Serum Solids	Percent Sugar	Percent Gelatine	Percent Total Solids
A 1	5	12	10	14	0.4	36
B 1	2	10	10	14	0.5	34
C 1	2	8	10.5	14	0.6	32.5

Series 2.

Not viscolized—

Mix Number	Number of Trials	Percent Fat	Percent Serum Solids	Percent Sugar	Percent Gelatine	Percent Total Solids
A 2	2	12	10	14	0.4	36
B 2	2	10	10	14	0.5	34
C 2	2	8	10.5	14	0.6	32.5

After the improvers had been added and permitted to act for twelve hours each lot was again tested for acidity and viscosity and immediately frozen. The six mixes which were used are found in Table I.

After freezing, the percent overrun obtained was recorded and the ice cream placed in the hardening room, where it remained for twenty-four hours, after which it was judged and tested for the following: flavor, body and texture, appearance and resistance.

Explanation of Ice Cream Improvers

An ice cream improver is neither a binder nor a filler and cannot be used as a substitute for either; however, some improvers contain material such as agar agar, gum tragacanth, india gum or gum arabic which are sometimes used as binders. The powdered improvers, generally, contain as the active principle, the rennet or pepsin enzyme, or both, in powdered form. (12) The outstanding characteristics of these enzymes is the ability to produce sweet curdling of milk.

The manufacturers of ice cream improvers claim that "improvers" improve the body and texture of the ice cream, thus imparting a more creamy appearance and rich flavor. Improvers reduce the time of aging or ripening of the mix thereby retarding the time of action of the lactic acid bacteria and also increase the viscosity of the mix making possible a higher percent of overrun.

Each improver is added to the mix in a different manner. Some are added directly to the mix, some are mixed with sugar and added while others must first be dissolved in water. Practically all are added immediately after the mix has been processed and cooled. The temperature ranges from forty to sixty degrees F. At the present time there is a new form of improver on the market which is added before pasteurization. No experiments were made with this improver.

Identification of Improvers

In order to determine the nature of each improver under discussion a qualitative test was made of each as follows: coagulating enzymes, gums, agar agar and dextrin. No quantitative tests were made. Morgenroth's method was used for the detection and strength of coagulating enzymes, and for the detection of gums, agar agar and dextin Cook and Woodman's method was employed.

The numbers here given will be used throughout the report to represent the individual improver as it is not considered ethical to publish the names of the improvers under discussion.

2. Rennet in liquid form
3. Coagulating enzyme and gum
4. Coagulating enzyme
5. Coagulating enzyme and dexterin
6. Coagulating enzyme and gum
7. Gum tragacanth
8. Coagulating enzyme and gum
9. Agar agar
10. Gum arabic
11. Gum tragacanth

It will be noted that of the ten improvers under discussion, six contained, as the active principle, a coagulating enzyme. This enzyme in all probability was either rennet or pepsin. A further discussion and experimental data of the physical and chemical effect of ice cream improvers upon the mix will be found in Part II.

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PART II.
PHYSICAL AND CHEMICAL EFFECT OF ICE CREAM IMPROVERS

Explanation of Improver Action

As shown in Part I the improvers under discusison contain as the basic ingredient a coagulatinig enzyme or gum.

It is a recognized fact among ice cream makers that in order to obtain a good texture and yield in ice cream it is necessary to age or ripen the mix, after processing for twelve to forty-eight hours at a temperature of thirty-six to forty degrees F., thus producing an increase in viscosity. The change which takes place during the ripening process is not fully understood but according to Profitt (2) the physical change taking place is due to a certain hardening of the butter fat and protein.

Albright (8) describes the aging process in the following manner: "The casein, which was present in the original milk in minute collodical particles composed of calcium caseinate is liberated from its calcium combination by the action of lactic acid. When lactic acid develops to excess the casein flocks together to form the familiar curd or clabber. The casein particles are swelled by water in the presence of the acid. Normal ripening is therefore due primarily to the development of lactic acid."

By the action of rennet casein is converted into paracasein. (9) The length of time for this change to take place depends upon three factors: First, the strength of the rennet. Second, the amount of the rennet used. Third, the temperature of the mix to be coagulated. The action is not as rapid in a cold mix, while on the other hand the coagulating effect is destroyed above certain temperatures. (10) These coagulating enzymes would therefore cause an increase in viscosity depending upon the temperature of the mix, amount and strength used.

For us to understand the action of the improvers without a coagulating enzyme it is necessary to study the nature and action of the other basic principle which is a gum.

In Part I we stated that a mix might contain between thirty-two percent to forty percent total solids. The remaining portion of the mix is water.

The most important physical property of a gum is its ability to take up and hold within itself large quantities of water without affecting its colloidal property. (6)

It can be readily seen that if gum is added to the mix some water in the mix will be taken up by the gum thus preventing it from freezing out in crystalline form, and at the same time causing an increase in viscosity by binding the casein particles more closely together. The principles of the action of ice cream improver is thus explained.

The Effect of Ice Cream Improvers upon the Acidity of the Ice Cream Mix

To determine whether improvers had any effect upon an ice cream mix, the acidity was taken immediately after the mix had been processed and cooled. The improvers were then added to ten different lots and one lot was retained as a control. After the mix was permitted to stand for twelve hours, the minimum time for normal aging, the acidity was again taken. The acidity was obtained by titration with tenth normal alkali solution. The result of this experimental work is summarized in Tables II and III.

A study of Tables II and III reveal the fact that there is no increase in acidity, it remaining constant with the exception of five cases and these varied only within the limits of error.

Table II.—The Effect of Ice Cream Improvers on the Acidity of a Pasteurized and Viscolized Mix

Acidity Expressed in Hundredths of One Percent

Sample Number	Mix C 1 Ave of 5 Trials		Mix A 1 Ave. of 3 Trials		Mix B 1 Ave. of 3 Trials	
	Initial	After Aging 12 Hours	Initial	After Aging 12 Hours	Initial	After Aging 12 Hours
Control 1	.22	.22	.19	.19	.18	.18
Improver 2	.22	.22	.19	.19	.18	.18
3	.22	.22	.19	.19	.18	.18
4	.22	.215	.19	.185	.18	.185
5	.22	.22	.19	.19	.18	.18
6	.22	.22	.19	.19	.18	.18
7	.22	.22	.19	.19	.18	.185
8	.22	.22	.19	.19	.18	.18
9	.22	.22	.19	.19	.18	.18
10	.22	.225	.19	.195	.18	.18
11	.22	.22	.19	.19	.18	.18

Table III.—The Effect of Ice Cream Improvers on the Acidity of a Pasteurized Mix Not Viscolized

Acidity Expressed in Hundredths of One Percent

Sample Number	Mix A 2 Ave. of 3 Trials		Mix B 2 Ave. of 3 Trials		Mix C 2 Ave. of 3 Trials	
	Initial	After Aging 12 Hours	Initial	After Aging 12 Hours	Initial	After Aging 12 Hours
Control						
1	.21	.21	.20	.20	.19	.19
Improver						
2	.21	.213	.20	.20	.19	.19
3	.21	.21	.20	.20	.19	.19
4	.21	.21	.20	.20	.19	.187
5	.21	.21	.20	.20	.19	.19
6	.21	.21	.20	.20	.19	.193
7	.21	.21	.20	.20	.19	.19
8	.21	.21	.20	.20	.19	.19
9	.21	.21	.20	.20	.19	.19
10	.21	.21	.20	.20	.19	.19
11	.21	.21	.20	.20	.19	.19

From this information we would conclude that ice cream improvers will not retard the development of lactic acid bacteria, neither will they accelerate their growth.

The Effect of Improvers upon the Viscosity of a Mix

To determine whether improvers had any effect upon the viscosity a test was made immediately after the mix had been processed and cooled. The viscosity was determined by the use of a fifty cubic centimeter volumetric pipette and stop watch. All viscosity tests were made at a temperature of forty degrees F. and all samples were agitated fifteen seconds before readings were made. After the mix was permitted to stand for twelve hours, the mix was again tested for viscosity. The percentage of increase in viscosity is recorded in Table IV.

An examination of Table IV indicates that all the improvers used increased the viscosity of the mixes over the viscosity in the control mix. It will be further noted that the series of viscolized mixes increased more in viscosity than did the non-viscolized mixes. Not only was this true in regard to the improvers but also in the case of the control. This would lead us to conclude that the process of viscolization changes the physical condition of the casein so that the enzyme action is more rapid. A further study of Table IV shows that improvers do aid the normal aging and cause an increase in viscosity, in a shorter period of time thus obtaining the desired result without prolonged aging.

Table IV.—The Effect of Ice Cream Improvers upon the Viscosity of an Ice Cream Mix

Expressed in Terms of Percent Increase

Sample Number	Viscolized Mix			Non-Viscolized Mix		
	A 1	B 1	C 1	A 2	B 2	C 2
Control						
1	80.0	57.1	65.0	23.0	22.7	44.4
Improver						
2	671.1	365.0	900.0	670.0	130.2	42.0
3	145.7	78.5	85.0	100.0	40.0	61.1
4	91.5	78.5	85.0	55.0	34.9	55.5
5	128.8	92.8	75.0	77.0	20.9	61.1
6	133.3	92.8	110.0	38.4	26.0	55.5
7		92.8	90.0	23.0	20.9	55.5
8	92.8	107.1	80.0	23.0	23.1	66.6
9	172.5	85.0	85.0	23.0	37.2	66.6
10	122.5	64.2	65.0	30.7	26.0	83.3
11	100.0	85.0	65.0	23.0	32.5	55.5

The Effect of Ice Cream Improvers upon the Swell or Overrun

All the ice cream mixes with the exception of A 1 were frozen in a six quart upright freezer, driven by an electric motor. Mix A 1 was frozen in a forty quart horizontal brine freezer which is standard equipment in the college creamery. Mix A 1 contains thirty-six percent total solids and is the mix used in the manufacture of college ice cream, therefore it was frozen to obtain one hundred percent overrun on each batch regardless of time or temperature. The other five mixes being frozen in an upright freezer it was impossible to determine when the desired overrun was obtained. Therefore a uniform mixture of ice and salt was used at all times and each batch was frozen the same length of time. At the end of this period the overrun test was made with the De-Raef overrun standardizer and the percent of overrun calculated from this reading. The tabulated results are given in Table V.

Table V.—The Effect of Ice Cream Improvers on the Swell or Overrun of Ice Cream

Overrun Expressed in Percent
Average of Four Trials on Eeach Lot

Sample Number	Mix A 1	Mix B 1	Mix C 1	Mix A 2	Mix B 2	Mix C 2
Control						
1	100	75	75	75	75	70
Improver						
2	100	75	75	75	75	75
3	100	75	70	75	75	70
4	100	75	75	75	75	70
5	100	75	75	75	75	75
6	100	75	75	75	75	80
7	100	75	75	75	75	75
8	100	75	75	75	80	75
9	100	75	75	75	75	75
10	100	75	72	75	75	70
1	100	75	75	75	75	77½

These results are an average of four trials on each lot, therefore might be considered fairly reliable. However, it will be noted that in a few cases there is a variation in the percentage of overrun. With the exception of Mix C 2, the results are very uniform. In the case of C 2, which contains thirty-two and one-half percent total solids and is not viscolized, we would conclude that some improvers have a decided effect upon the overrun of a mix of this nature.

Relative to the other five mixes we would conclude that improvers are of no value in securing additional overrun. On the other hand the overrun was not decreased over that obtained in a normal mix as shown by the control.

The Effect of Improvers upon the Flavor of Ice Cream

In determining the effect of improvers upon the flavor it was necessary to rely wholly upon judgment. This brings forth a large amount of criticism because it is a well known fact that people do not all judge the same. One individual may think something is excellent while others would say it was valueless. This being the case, it was deemed necessary to have a large and varied number of judges to determine the flavor. For this purpose a mix containing thirty-six percent total solids and viscolized (A 1) was made to which the improvers were added as previously explained. During the ice cream makers short course in February there were forty-five manufacturers, from several states, present who were asked to judge this ice cream. The score card used was the one recommended by the Oklahoma Agricultural and Mechanical College, arranged by Professor A. C. Baer, head of the dairy department.

A brief summary of the decisions of the forty-five individual judges follows:

Thirty-two judges could tell no difference in the eleven samples.

Nine judges placed number one first.

Three placed number three first.

One placed number four first.

No other sample received a first place; however, every sample except one received a second place.

Out of the forty-five judges five placed number three first.

Because of the large number placing number one first it was thought perhaps there might have been some influence because they had tasted number one first so the following day the same samples differently numbered were placed before the same forty-five judges. When these samples were renumbered, the numbers were advanced one, thus sample number one became sample number two, two became three, three became four, etc. The summary of the second day, in the terms of the original numbers, follows:

Samples number three, five, six, seven, eight, nine and eleven respectively were placed first by one judge each. All of these contained improver. Sample number one tasted to one judge as if it had too much improver yet this was the control sample and contained no improver. Two judges placed number three last.

In referring back to the summary of the first day we find nine judges placing number one first, yet on the following day these same judges could not determine which sample they had considered the best ice cream the previous day.

Table VI.—The Effect of Improvers on the Flavor of Ice Cream

Scored for flavor according to the Oklahoma A. and M. College score card for ice cream. Arranged by Professor A. C. Baer, head of the dairy department.

Perfect Score, 35 Points

Sample Number	Mix A 1	Mix B 1	Mix C 1	Mix A 2	Mix B 2	Mix C 2
Control						
1	33.5	32.0	32.0	32.5	32.5	30.0
Improver						
2	33.5	32.5	32.5	32.7	33.0	30.6
3	33.0	32.0	32.5	32.5	32.5	30.6
4	33.5	33.0	32.3	32.5	32.5	31.0
5	33.5	33.0	32.5	32.7	33.0	30.0
6	33.5	33.0	32.5	32.5	33.0	30.0
7	33.5	32.7	32.7	32.7	32.7	30.5
8	33.5	33.0	32.5	32.7	32.6	30.0
9	33.5	32.3	32.2	32.7	32.5	30.5
10	33.5	32.7	32.3	32.5	32.5	30.0
11	33.5	32.5	32.5	32.6	32.5	30.5

According to the above summaries, it can be concluded that there is no improvement in flavor by the use of improvers, on ice cream containing thirty-six percent total solids or more. In fact if there is any advantage it would be in favor of the ice cream containing no improvers.

The remaining five mixes were judged by five members of the dairy department and a class in ice cream making. Their judgment was summarized into a composite score which is shown in Table VI.

From a study of this table we would conclude that improvers do improve the flavor of ice cream; however, in the writer's opinion it is not the flavor itself which has been improved but because of the lack of crystallization of the ice cream made with improvers a smoother and richer taste is brought about. This is corroborated by the decision of the judges which were accompanied by such criticisms as the following: coarse, watery, grainy and icy, thus indicating that a creamy or smooth taste was to be preferred above one of watery nature. This probably accounts for the low score on mix C 2, which was not viscolized and contained only thirty-two and one-half percent total solids, causing it to be very coarse. The scores awarded A 2, a mix not viscolized, and which contained thirty-six percent total solids, would indicate that the "improvers" did not materially improve the flavor of these lots.

We would then conclude that improvers have a direct influence on the flavor of ice cream with a low percentage of total solids, by giving the ice cream a smoother body and texture, imparting a rich creamy flavor. On the other hand the flavor of ice cream containing an average or a high percent of total solids is not materially changed by the use of improvers.

The Effect of Improvers upon the Body and Texture of Ice Cream

For the determination of the effect of improvers upon the body and texture of ice cream the same procedure was followed as for flavor.

The Oklahoma Agricultural and Mechanical College score card for ice cream was used. The relative scores for body and texture are found in Table VII.

Table VII.—The Effect of Improvers on the Body and Texture of Ice Cream

Score for body and texture according to the Oklahoma A. and M. College score card for ice creams. Arranged by Professor A. C. Baer, head of the dairy department.

Perfect Score, 15 Points

Sample Number	Mix A 1	Mix B 1	Mix C 1	Mix A 2	Mix B 2	Mix C 2
Control						
1	14.5	13.0	12.0	13.5	13.5	11.0
Improver						
2	14.5	13.5	13.5	14.0	13.8	12.2
3	14.5	13.0	13.0	14.0	13.5	12.0
4	14.5	14.0	13.5	14.0	13.5	13.0
5	14.5	13.6	13.0	13.5	13.8	11.0
6	14.5	14.0	13.5	13.5	13.8	12.0
7	14.5	13.6	13.0	13.5	13.5	12.0
8	14.5	14.0	13.5	14.0	13.5	12.0
9	14.5	13.2	13.0	14.0	13.5	11.0
10	14.5	13.6	13.0	14.0	13.5	12.0
11	14.5	13.5	12.5	13.5	13.5	11.0

An examination of this table indicates that, with the exception of A 1, the ice cream was improved to a slight extent. This improvement in all probability was due to the increased smoothness of the ice cream and the lack of crystallization. It will be noted that the ice cream with a higher percentage of total solids resulted in a smaller variation of score than did the ice cream with a total solids content of thirty-two and one-half percent.

From this data we may conclude that improvers do improve the body and texture of ice cream within certain limits, exerting a more decided influence on a mix of low solids content and decreasing the effects inversely in proportion to the percent of total solids used and method employed in processing.

The Effect of Improvers upon Melting Resistance

An ice cream made in the proper manner should remelt into the same condition as it was before frozen. If too much gelatine is used, which is often the case, the ice cream will not melt and long after it has thawed out will stand up like a sponge. It is therefore essential that a good grade of gelatine be used and at the same time, enough should be used to give the ice cream sufficient resistance from melting immediately, yet, not too much so that it will prevent the mix from melting back to its original state.

The mixes used in these experiments contained the correct percentage of gelaine and the melting resistance of all the samples containing improvers should be approximately the same as the control.

The method used in the determination of the melting resistance is described by V. C. Manhart (11) in the September, 1922, issue of the Ice Cream Review.

A sample of ice cream was taken from each lot to be tested. These samples were of equal volume and weight. They were on a number twelve mesh screen wire over a weighted beaker in a room with a temperature between eighty-four and ninety degrees F. At the end of thirty minutes the beakers were weighed and the gain in weight indicated the amount melted. From this the percentage of ice cream melted was calculated. The results obtained in this experiment will be found in Table VIII.

Table VIII.—Effect of Improvers on the Melting Resistance of Ice Cream

Percent Ice Cream Melted in Thirty Minutes

Sample Number	Mix A 1	Mix B 1	Mix C 1	Mix A 2	Mix B 2	Mix C 2
Control						
1	94.7	98.0	82.0	41.2	66.6	80.0
Improver						
2	12.5	13.0	10.5	15.0	15.7	9.5
3	12.5	25.0	18.0	21.0	47.3	35.0
4	12.5	37.3	21.5	15.0	27.7	52.3
5	12.5	48.0	26.5	21.0	52.9	66.6
6	18.7	43.7	23.4	25.0	57.9	55.0
7		58.0	31.6	25.0	61.1	78.0
8	18.7	25.2	17.8	25.6	37.5	55.5
9	94.5	48.0	29.5	25.0	47.3	99.5
10	62.5	56.0	33.5	25.6	57.9	80.0
11	75.0	63.0	37.0	25.0	52.9	77.7

A study of this table reveals the fact that the melting resistance is greatly increased by ice cream improvers. This is especially true where the coagulating enzyme is present. The cause for this is that as the ice cream begins to melt the coagulating enzyme becomes active thus causing the mix to curdle which prevents it from passing through the screen.

The increase of the melting resistance is of great importance to the ice cream manufacturer in that if the ice cream is served to the trade in an ice cream soda and fails to melt, a customer would in all probability be lost. Ice cream sold to soda fountains should, therefore, not contain a coagulating enzyme because of the increase in melting resistance.

The Effect of Ice Cream Improvers upon the Appearance of a Remelted Mix

After the ice cream had melted for thirty minutes, notation was taken of the appearance of the mix. The following condition was found to exist in all six mixes relative to each sample.

Control 1. Nicely melted, creamy appearance.

Improver 2. Spongy, partly curdled as if beginning to whey off.

Improver 3. Spongy, partly curdled, hardly any passed through the screen.

Improver 4. Spongy, partly curdled.

Improver 5. Slightly spongy, foamy, not quite curdled as much as two, three and four.

Improver 6. Slightly spongy, foamy, slightly curdled.
Improver 7. All nicely melted, creamy appearance but slightly foamy.
Improver 8. Slightly foamy, spongy, curdled slightly.
Improver 9. Nicely melted, creamy appearance.
Improver 10. Very slightly spongy, otherwise nicely melted.
Improver 11. All nicely melted, creamy appearance.

It will be noticed that improvers number seven, nine and ten compared favorably with the control in appearance after the mix had been remelted. From this information we would conclude that most improvers detract from the appearance of a remelted mix.

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PART III.

THE ECONOMIC VALUE OF ICE CREAM IMPROVERS

Actual Cost of Improvers

The value of anything depends on how well it serves its purpose. Our results show that improvers do not affect acidity, do slightly increase viscosity, exert no influence on flavor, body and texture or overrun except in mixes of low solids content and increases the melting resistance beyond a point which would make them undesirable for ice cream sodas. The questions then arise, what do improvers cost? Are they worth the price? In Table IX is shown the price per pound, the amount used in one hundred gallons of mix and the cost per hundred gallons of mix.

Table IX.—Amount and Cost of Improvers for One Hundred Gallons of Mix

Improver Number	Cost of Improver Per Pound	Amount Used for 100 Gallons Mix	Cost Per 100 Gallon Mix
2	.40	400 cc	32.5c
3	.85	15 oz.	79.6c
4	.75	10 oz.	46.8c
5	.60	10 oz.	37.5c
6	.90	10 oz.	56.2c
7	.22	10 oz.	13.7c
8	.60	10 oz.	37.5c
9	.45	10 oz.	28.1c
10	.85	10 oz.	53.1c
11	.50	10 oz.	31.2c

Economic Effects of Improvers on Storage of Ice Cream

Many inquiries have come to the dairy department of the Oklahoma Agricultural and Mechanical College relative to the cause of ice cream shrinking away from the sides and sinking in the can. As it was previously explained some leading authorities claim that this shrinkage is due to the use of improvers. For this reason Mix A 1, which contained thirty-six percent total solids and was viscolized, was frozen and placed in the hardening room to be observed for shrinkage. The samples were removed from the hardening room and checked once every two weeks to see if any change had taken

place. These observations were made from February 21 to April 18. The results of the observations are summarized in Table X.

Table X.—The Effect of Improvers on Shrinkage of Ice Cream

Sample Number	Amount of Shrinkage After—			
	Two Weeks	Four Weeks	Six Weeks	Eight Weeks
Control				
1	none	none	none	very slight
Improver				
2	very slight	slight	bad	very bad
3	none	very slight	very slight	bad
4	none	very slight	very slight	bad
5	none	very slight	slight	bad
6	none	very slight	slight	bad
7	none	none	very slight	slight
8	none	very slight	slight	bad
9	none	none	very slight	slight
10	none	none	very slight	slight
11	none	none	very slight	slight

A study of Table X indicates that improvers have a decided effect upon the shrinkage of ice cream. A further study of this table shows that th improvers containing a coagulating enzyme shrank more than did those containing only gum. At the same time the improvers containing only gum began shrinking two weeks before the control. This brings forth another si nificant fact and that is, the sample containing improver number two had begun to shrink at the end of the first two weeks and had the greate shrinkage at the end of eight weeks. This improver is liquid rennet a because of its high concentration may have caused shrinkage to take place more rapidly.

We may conclude from these observations that improvers have a decid effect upon the ice cream in storage and those containing as the active principle a coagulating enzyme more seriously affect the condition of ice cream when stored.

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SUMMARY

1. Ice cream improvers do not affect the acidity of a mix.
2. Ice cream improvers slightly increase the viscosity of a mix.
3. Improvers do not materially affect the overrun.
4. The flavor of ice cream is not improved except in mixes of low solids content. This probably being due to a smoother body and texture caused by the improvers.
5. Ice cream improvers retard crystallization to a noticeable extent in mixes containing thirty-four percent total solids or less.
6. Improvers result in an economic loss in ice cream storage by causing or increasing shrinkage in the cans.
7. The melting resistance of the ice cream is increased beyond a point where it would not be desirable for use in ice cream sodas.
8. Improvers are not necessary or desirable in the manufacture of a high grade ice cream containing thirty-six percent total solids or more but may

be used to an advantage in ice cream which has not been viscolized, containing thirty-four percent total solids or less.

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