EFFECTS OF INGREDIENTS AND PREPARATION PROCEDURES UPON COMMERCIAL TYPE FROZEN FRUIT PUREE DESSERTS

by

GLEN ALFRED LUNDEEN

A THESIS

submitted to

OREGON STATE COLLEGE

in partial fulfillment of
the requirement for the
degree of

MASTER OF SCIENCE

June 1949

APPROVED:

Professor of Food Technology Department
In Charge of Major

Head of Department of Food Technology

Chairman of School Graduate Committee

Dean of Graduate School

E.W. 11/6/49

ACKNOWLEDGMENT

The writer wishes to express his sincere appreciation to Dr. Oliver J. Worthington, major professor, for his aid in planning this experimental work and for his helpful suggestions and friendly counsel given throughout the advancement of this study.

Special thanks are also due to Mrs. Ethelmae Thomas for the conduction of the taste tests in connection with this work.

TABLE OF CONTENTS

TABLE OF CONTENTS continued

page

LIST OF TABLES

TABLE OF CONTENTS continued

page

LIST OF FIGURES

EFFECTS OF INGREDIENTS AND PREPARATION PROCEDURES UPON COMMERCIAL TYPE FROZEN FRUIT PUREE DESSERTS

INTRODUCTION

The vanishing supplies of ice cream during the war years gave impetus to the development of a pure frozen fruit dessert. Early work on this type of dessert was carried out at the Western Regional Research Laboratory of the U. S. D. A. In reports on different projects at that laboratory, D. G. Sorber (18) in 1943 indicated that H. I. Loeffler was developing formulae for this type of dessert. The new dessert was registered under the name "Velva Fruit" several years later (21).

Pureeing and freezing would be an excellent way of handling and preserving much fruit that now goes to waste. In the summer, when fruits are available in large quantities, it is sometimes difficult to preserve all that we would like to have for the winter months. Also, there are often local surplusses of dead-ripe fruit which can not be marketed through the regular channels because it will not stand handling; or, if it is marketed it must be sold at once, often at a lower price to avoid loss from spoilage. Such fruits, if preserved promptly will yield an excellent product rich in natural fruit flavor and sweetness. Preparation of purees offers a fine method of preserving excess or dead-ripe fruit, especially fruit that is too soft to withstand the processing

involved in canning or in freezing. This is particularly true of berries, peaches, plums, apricots, and to a somewhat less degree of cherries and grapes. In addition certain varieties of many fruits, such as some varieties of peaches, are too soft to be suited for shipping.

Since W. R. R. L. "Velva Fruit" was found to be an appetizing dessert of promise, it was decided that further research work should be done using other stabilizers and other procedures to see what could be done with desserts of this type.

Generally speaking, one could expect that frozen fruit puree desserts have a great market potential. Fruit puree desserts having the natural pure flavor of the fresh fruit, appealling appearance, consistency, texture and melt down characteristics very similar to those of ice cream should become an item of considerable importance in the food habits of the nation. The nature of the market available for this type of a dessert could be predicted from the large American consumption of ice cream.

Frozen fruit puree desserts have also certain qualities which their competitors such as fruit ices, sherbets and ice cream fail to show.

Fruit ices and sherbets which contain not more than 20% by weight of fruit juice, have a low overrun while

the new frozen fruit dessert which has a fruit content of 60% or more has an overrun of about 100%. The latter have also a better flavor and consistency.

Even though the fruit dessert such as "Velva Fruit" was first developed during the war when ice cream was scarce, there exist some good reasons why there should still be a large market for this type of product. Some people who watch their diets would rather eat a fruit dessert than ice cream. The former contains about 153 calories* per 100 gm. for a 35 Brix dessert as compared to about 222 calories per 100 gm. of the latter. (11, p. 732) The flavor of the frozen fruit puree desserts is probably also more desirable to most people than that of ice cream. It is a pure, unchanged flavor of the fresh fruit which should appeal to the general public.

The preparation of these frozen puree desserts is very simple and also cheap. The ingredients are fruit puree, sugar and a low percentage of a stabilizer such as gelatin. These have to be mixed according to a certain procedure depending on the stabilizer used, then whipped and frozen in an ice cream freezer. The product

---

* This amount was calculated on the basis that the fruit dessert contains 35 percent carbohydrates and 1 percent of fat and protein.

thus prepared can be stored for several months with little signs of deterioration either in flavor or in color. The frozen fruit desserts prepared at this laboratory did not contain any milk solids and had a pleasing smooth and soft texture similar to that of ice cream.

Briefly, the preparation of frozen fruit desserts on a large scale could save much overripe waste fruit and it would bring into the American home a new, very appealling and economical dessert.

SURVEY OF THE LITERATURE

(A) Factors Necessary to Make a Good Puree.

The preparation of a desirable frozen fruit dessert, even though it may seem very simple at first, involves a large number of factors which have to be taken into consideration (17). First of all, not every type of fruit and not every variety of a fruit results in a desirable product. In some cases the flavor is too mild to start with, or rapid changes in flavor take place during their preparation and subsequent storage under freezing conditions. The first consideration should therefore be that the variety possess a pronounced characteristic flavor. Of course an attractive color of the finished product is nearly as important. The aesthetic value of the dessert very much determines whether the public will accept it or not. On the other hand a deficiency in the color could be remedied by the addition of artificial colors. The variety should also be stable organoleptically, i.e. present no changes or little changes in flavor and color. Such changes may be produced by enzymatic systems or by catalytic action of certain metals such as tin, iron, zinc, and copper. It is also very important that the fruit should be picked when fully mature.

The freezing of the dessert also involves a number of problems. It is claimed to be necessary to follow certain rigid procedures in order to obtain a product of smooth texture. (19, p. 412-413). The degree of smoothness depends upon: (1) the rate of heat exchange during freezing, (2) the percentage of water and soluble solids in the puree, (3) proportion, particle size, and distribution of insoluble solids (e.g., pulpy and colloidal material that make up the cellular structure of the fruit). The nature of the protective colloids, e.g., pectin, and the amount of agitation employed during freezing are other important factors in controlling the smoothness of the frozen product.

Tressler and Evers (19, p. 413) state that they are doubtful whether the frozen fruit desserts (without stabilizers) will become popular since it is difficult to get the frozen purees at the proper temperature. Their opinion is that when eaten at just the right temperature to have the proper degree of softness, the frozen sweetened fruit purees are delicious. If the products are too hard or are thawed, they are not so pleasing.

Nevertheless the above difficulty in the proper temperature control could be overcome by the addition of

certain stabilizers. The use of different stabilizers is nevertheless a problem in itself and will be discussed in detail later.

(B) Report on "Velva Fruit".

Most of the work on the preparation of the "Velva Fruit" has been done by the Western Regional Research Laboratory. The dessert is made from fruit purees, sugar, and gelatin. It has a texture and consistency of ice cream and retains the delicate and distinctive pure fruit flavor. Its vitamin content is also high (2). The sugar content of "Velva Fruit" gives it about the same hardness as that of ice cream under similar conditions. There is some variation however with the type of fruit used. Desserts made from berries, for example, are softer than those made from pulpy fruits such as peaches (4).

The overrun varies somewhat with the fruit. Desserts prepared from buttery purees, such as peaches and apricots, tend to be dry and grainy when too much overrun has been produced. About 80 to 90% is satisfactory for this type of puree. These flavors are too delicate to stand great dilution. Highly flavored berry and plum desserts in contrast have had good texture and flavor with 100 to 110% overrun. Since the mixes have a different viscosity from ice cream mixes, the proper overrun settings on continuous

ice cream freezers may have to be determined by experiment (4).

Tests to compare the rate of melting of Velva Fruit with that of good quality ice cream (14% butterfat and 100% overrun) were made by placing samples of equal weights of youngberry Velva Fruit (containing sucrose) and ice cream on separate 8 mesh screens at room temperature. The fruit dessert melted no faster than the ice cream. The fruit dessert did not drain as completely as the ice cream because it does not melt to a liquid as ice cream does (4).

Substitute sugar is not required in Velva Fruit to stabilize the sucrose and to prevent its crystallization as in ices. The higher amount of stabilizer and fruit solids in these desserts prevent such crystallization. Crystallization has not occurred during accelerated storage tests over a period of six months (3). The type of suitable sweetening agent other than sucrose varies with the fruit. Corn sirup and other sweeteners containing destrin make the dessert stiffer, more melt resistant and add more body. Corn sirups can be used with the berry purees since they are of thinner consistency and can use these extra stiffening properties. Dextrose will not give extra stiffening, however, and can be used with fruits high in pectin content such as apricots,

peaches, prunes, and nectarines which are already quite stiff and melt resistant (4).

The best results with purees as liquid as strawberry or raspberry were obtained with 0.6% of 275 bloom gelatin. Fruits with more natural stabilizers require less. Purees with heavier body such as peach and apricot require only half as much. The tasters appraising the quality of the samples approved of the smooth texture obtained with the 0.6% gelatin in the raspberry (18).

Velva Fruit desserts can probably be stored for longer periods than ice cream. No "shrinkage" was noted during six months storage of Velva Fruit in 3.5 ounce waxed paper cups (3).

(C) Canadian Report on Fruit Puree Desserts.

During the 1945 - 1946 season, one of the Canadian experimental stations experimented with frozen fruit desserts (13). Their main object was to develop formulae and blends of desirable flavor and color and to determine the effect of storage on the finished product.

The ingredients of the fruit dessert were simply fruit puree, sugar and a low percentage of stabilizer, as gelatin. Most of the fruit used had already been stored at 0 F. for 6 to 20 months. The amount of 275 bloom gelatin depended on the consistency of the fruit and sugar and varied usually from 0.3 to 0.5% of the weight of the

fruit and sugar. In some cases also 0.6% could be used with good results. Larger doses of gelatin gave the finished product much lower comparative quality. A soluble solids content of approximately 35% in nearly all finished products was the most pleasing to the tasters.

The most outstanding products thus far produced were the pure strawberry, blackcurrant and raspberry desserts. These were superior to the other fruits and to any of the blends such as black currant blended with blueberry or apple. In the opinion of the majority of tasters the above products were superior to ice cream in their clean, fresh, tart flavor, and left no cloying after taste. They should therefore provide an exceptionally refreshing fountain dessert.

Their storage tests were also very favorable. The finished product did not appear to have changed in texture or in flavor with two to three months storage.

(D) Purpose and Properties of a Stabilizer.

In ice cream and analogous frozen desserts, small ice crystals tend to disappear and larger crystals tend to grow larger as a result of the alternate melting and freezing (to which ice cream is subjected) due to fluctuation of temperature during storage and transportation. In order to assist in the production and maintenance of

an even texture, to prevent shrinkage, and to assist in the incorporation of air, stabilizers are almost universally used in the manufacture of ice cream. Of these gelatin is probably the most common agent used (9, p. 415).

One of the most important factors in the manufacture of ices, sherbets, and frozen fruit purees is the choice of the stabilizer (9, p. 416).

The purpose of a stabilizer is to assist in the formation of a smooth texture and firm body and to a certain extent, to aid in controlling overrun.

The stabilizer accomplishes these purposes through its ability to form a gel and absorb water at low temperatures. This property of the stabilizer also enables it to prevent "bleeding" at low temperatues by giving the unfrozen sirup such viscosity that it will not flow downward through the ice to the bottom of the container.

The desirable characteristics of a stabilizer for frozen desserts may be summarized as follows: (1) its stabilizing qualities should not be greatly impaired by acids, (2) it should be easily dispersed in water, (3) it should have a desirable effect upon the texture and resistance, and should impart desirable melt-down characteristics to the ice or sherbet, (4) it should have sufficient effect upon the viscosity of the unfrozen portion of the ice to prevent "bleeding" or setting,

(5) it should not cause high overrun, yet should make it possible to obtain the overrun desired, (6) it should prevent ice separation when continuous freezers are used, (7) it should not cause an undesirable flavor in the finished product (20, p. 77).

(E) Description of Various Stabilizers Used

1. Methyl Cellulose Ethers.

These stabilizers are synthesized from purified cellulose by a reaction with methyl chloride in the presence of caustic soda. They are synthetic hydrophilic colloids with unusual properties. They are a cold water dispersible compound which is completely dispersible even at freezing temperature (10, p. 250).

Methyl cellulose is stable to heat, light and aging. Solutions retain their viscosity and standing over a wide range of pH conditions. Methyl cellulose is free from insoluble substances or extraneous matter. It produces clear, colorless, aqueous solutions (14, p. 146-147).

Methocel (Dow Methyl Cellulose Ether) has been shown to be non toxic, completely inert, neutral, odorless and tasteless. Since it is inert it has no food value and is excreted practically unaltered (10, p. 251). Methyl cellulose can be used for stabilizing purposes such as in the formation of oil-in-water emulsions and for thickening purposes. The mucilage is compatible with dilute acids containing acetic, citric or tartaric acid and it can be blended with colloidal aqueous solutions of casein, dextrin, water dispersible gums and starch (10, p. 251).

Methyl cellulose of American origin is produced in

six viscosity types to meet a wide range of use requirements. For use as a thickener, the 1500 cps. or 4000 cps. types of methyl cellulose are more economical. Dispersions of only 1 to 2% concentration of the 4000 cps. type are highly viscous (14, p. 146).

Methyl cellulose will form solutions, pastes and gels only in cold water and will not disperse in hot water but hot water does hasten the wetting out of the ether (10, p. 250).

2. KRIM - KO - GEL

This stabilizer is a derivative of Irish moss. It is recommended as a general purpose colloid. The active principle of the moss is the gel-forming carbohydrate known as gelose. This colloid thickens, gels, stabilizes, emulsifies and suspends solid particles in liquid solutions. It performs satisfactorily in the range of pH 4.0 to 7.0. It is sensitive to sustained high temperature processing and to acidity from pH 4.0 down to 1 (5, p.64). The best way to use it is to put it into complete solution by sprinkling it on the surface of cold water with vigorous agitation, heating this suspension to 160°F and holding it at this temperature for at least 15 minutes to insure complete solution of all the particles.

This colloid is now used in food and beverage manufacturing.

3. Amioca Starch

This is a new domestic starch (1, p. 3, 7, 9, 13) obtained from waxy maize. It is a satisfactory substitute for tapioca flour and other tuber starches. Ordinary corn starch gelatinizes at 64 C. and continues over a range of 30 C. or more, whereas amioca gelatinizes at 70 C. and proceeds over a range of only 8 C. This is significant under conditions where a minimum of cooking time is desirable. Amioca has a higher viscosity than potato starch when equal parts of water are used. Unlike corn starch pastes, it does not gel on cooling. Tapioca, on cooling to room temperature, becomes very much more viscous than Amioca, which bodies up only slightly. The properties of Amioca of not gelling or not setting, and freedom from objectionable tastes and odors may be quite important in some food recipes.

4. Gelatin

Gelatin is a product obtained by boiling skin, tendons, ligaments and bones with water. It is colorless or slightly yellow, transparent, brittle and practically odorless. It can absorb five to ten times its weight of

cold water. It is soluble in hot water (15, p. 143). The amount of water held by it is marketly affected by the temperature. This is desirable as at low temperatures at which the gelatin is to serve its purpose the amount of water held is highest while as the temperature is raised to the melting point of ice cream or above, the amount of water held decreases. This makes for ease in handling the mix in pasteurizing, homogenizing, cooling, and also makes proper stabilization possible without using so much gelatin that the ice cream on thawing yields a gluey liquid or a jellied liquid (16, p. 420).

The stage at which gelatin is beaten is important. If the beating is done at the time when the gelatin has set enough to be quite viscid, but has not become brittle, so that the edges break apart, the volume may be increased two or three times. The gelatin at this stage is elastic and streches to surround the air particles. If gelatin becomes too firm before the beating is started the gelatin only breaks and air is not incorporated (12, p. 187).

5. Pectin

Ordinary commercial high methoxyl pectin was the type used.

It has been recommended that the required amount of powdered pectin be mixed with six times its weight of sugar and dissolved in water at 60 to 70 C. The sugar prevents clumping of the pectin. Clumping is less at 60 to 70 C. than at 100 C. because at the higher temperature the sugar dissolves much more rapidly than the pectin, leaving it in suspension to form clumps. The mixture is stirred for several minutes and may then be heated to boiling to complete the dissolving of pectin (15, p. 358).

Dahle reported that pectin can be used as a stabilizer for ice creams with a resulting low viscosity which is a desirable point (7).

(F) Yield of Puree from Fruits.

The yield of pulp from berries is of interest to the manufacturer of purees; The Food Technology Department at Oregon State College, in 1937 - 1938 did some investigation work with certain fruits to determine the pulp yield (23, p. 13-14). The fruit was forced through a cyclone type sieve which separated the seeds from the juice and cellular material. Results of these studies show the following significant yields: Raspberry 87.6%, Boysenberries 93%, Youngberries 90%, Loganberries 81.6%, blackberries 97%, and Strawberries 97%. The loss is due to the presence of seeds.

(G) Use of Sucrose Substitutes.

Several sucrose substitutes have been used in ice cream making such as dextrose, corn sirup, and corn sirup solids. Corn sirup solids (Frodex) result from the dehydration of corn sirup to a stable white product, which to an outward appearance resembles confectioners sugar (20, p. 70-72).

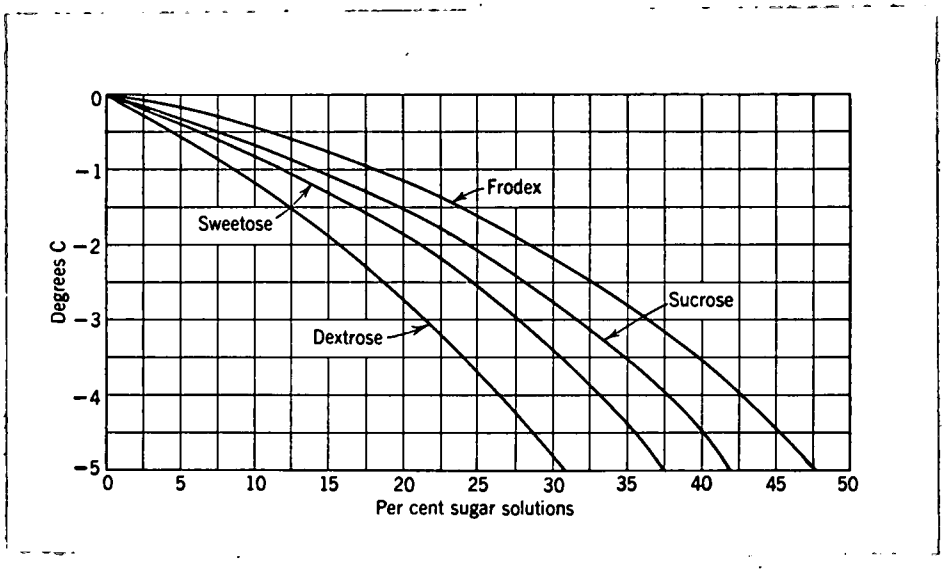
Of these corn sirup has been most widely used. According to Glazier and Mack (8), when it is used to replace part of the sucrose normally employed, it gives better body and texture in ice creams, sherbets and ices without significantly changing the sweetness of the product.

Consumer judgements of ice cream containing corn sirup solids to replace 20 to 26.6% of the sucrose revealed that a combination of sweeteners is desirable. If corn sugar, corn sirup, or honey is used in place of part of the sucrose a reduction of the freezing point will occur. If Frodex (corn sirup solids) is used in place of part of the sucrose, the freezing point will be raised because of the greater percentage of substances of high molecular weight contained in this product (8).

The variation in the body and texture and rate of melting of ice cream caused by the different corn

sweeteners appear to be of greater significance than the variations in the sweetness. Corn sirup solids raise the freezing point of ice cream slightly, increase the mixtures viscosity and decreases somewhat the rate of melting. They also have very little effect on the whipping ability of the product (8).

FIGURE 1. Freezing Points of Sugar Solutions (20)



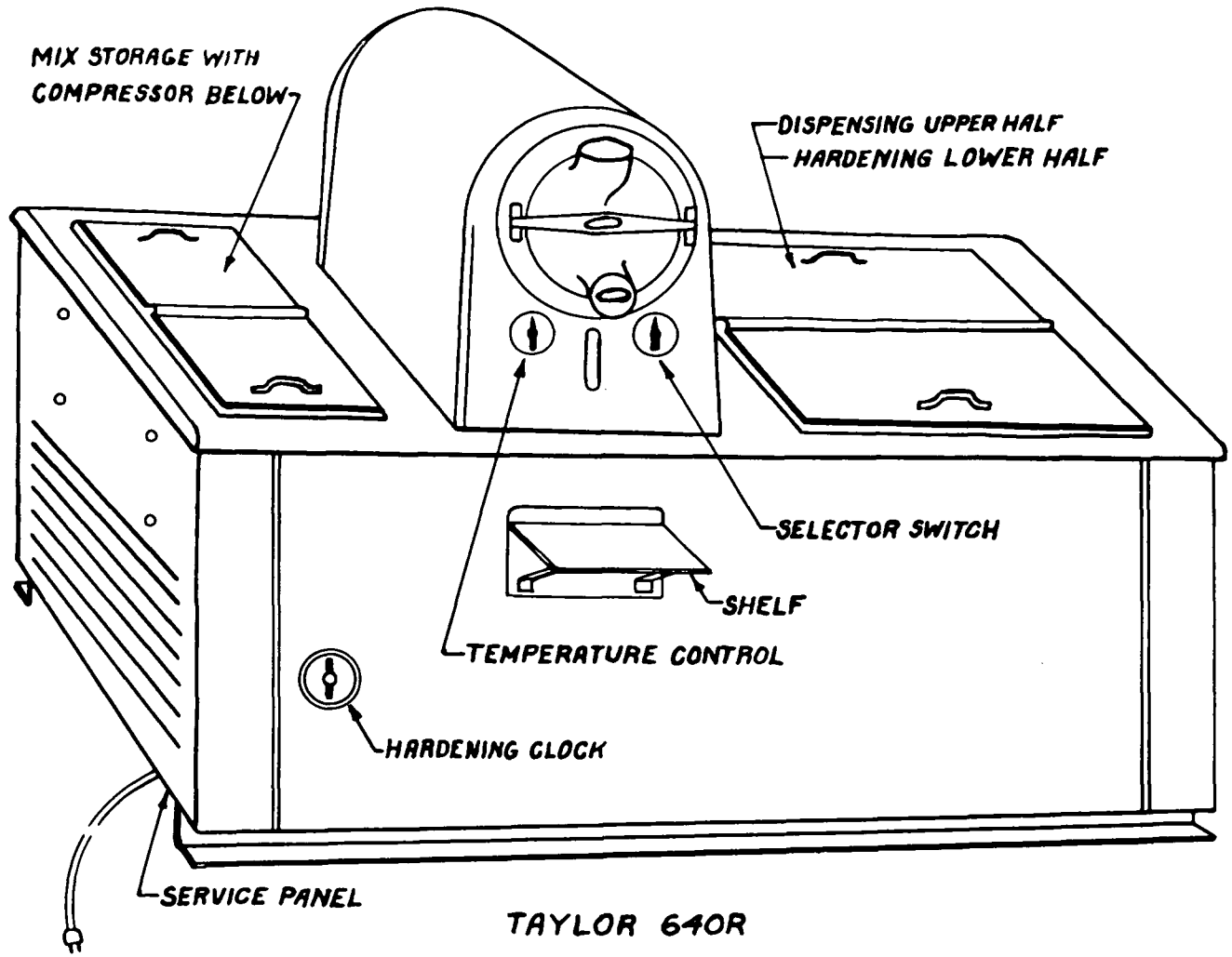


FIGURE II. Taylor Freezer used in Experiments

EXPERIMENTAL PART

(A) Preparation of the Boysenberry Puree.

In this investigation only boysenberries of good quality were used. They were washed, then passed through a small cyclone pulper with a fine screen. This eliminated all the seeds. The yield was about 89 percent. Then the purees were frozen until ready for use.

(B) Chemical Composition of the Boysenberry Puree

The boysenberry puree to be used for the preparation of frozen fruit desserts was analyzed early in the experimentation. Results are given below in table I.

TABLE I

CHEMICAL COMPOSITION OF THE BOYSENBERRY PUREE

Total acidity (as citric acid)	1.2%
pH	3.1
Soluble solids (by refractometer)	10.5%
Insoluble solids	2.3%

(C) Preparation of the Frozen Fruit Desserts

For freezing of the desserts a six quart Taylor batch type freezer (Model 640 R) was used. Its second

fastest speed (209 R.P.M.) was used throughout the experiments. The freezing was continued until the proper consistency was obtained upon trial withdrawal of a portion. The product was packed in lightly waxed pint cartons and hardened at 20 F. Overrun was determined by weighing a cup of the mix before beating and freezing, and weighing a cup of the finished dessert later. Percent overrun was then calculated by using the following formula:

$$\text{Percent overrun} = \frac{100 \times \text{wgt. per cup mix} - \text{wgt. per cup dessert}}{\text{wgt. per cup dessert}}$$

The thawed purees containing ice crystals were kept in a cool place (32F) while being used. The puree for each batch was brought to the desired mixing temperature by heating slowly with continuous stirring over a gas flame.

The percentage of soluble solids in the dessert was determined by means of a refractometer.

Slightly different procedures had to be used with different stabilizers. The gelatin mix was made by mixing the gelatin with several times its weight of sucrose. Boiling water was then added and the product was dissolved by stirring. After a few minutes, when the gelatin was dissolved, it was poured slowly with constant

stirring into the sweetened puree which has been previously warmed to about 75°F. Then the dessert was frozen.

The Methocel (Dow methyl cellulose ether) mix was made by combining the Methocel with about twice its weight of sucrose and then adding boiling water. This mixture was stirred, set aside for about half an hour and then poured with constant stirring into the sweetened puree which could be between 32°F. and room temperature. Then the dessert was ready to be frozen.

The cornstarch, Amioca, and Clearjel desserts were prepared by mixing the stabilizer with several times its weight of sucrose. Then cold water was added and the mixture was stirred until well dissolved. Next the mixture was heated in a double boiler (steam jacket heat) with stirring until a translucent, viscous gell was formed. This gell was mixed with the sweetened puree which had been previously heated to about 75°F.

The pectin dessert was prepared by combining the pectin (150 grade) with half a cup of sugar. Then boiling water was added and the mixture was stirred. After a few minutes the pectin mixture was slowly added to the sweetened puree again with stirring.

The Vel-O-Teen and the Vestirine desserts were made by the same procedure as used in making the gelatin desserts.

The Krim-ko-gell was mixed with several times its weight of sucrose. To this the cold water was added with stirring. The mixture was heated to dissolve and added to the sweetened, warmed puree.

When Frodex (corn sirup solids) sugar was used as a sucrose substitute, it was necessary to weigh out the desired amount, to add it to a quantity of the puree and to beat it up in a Waring blender to dissolve it from its original rock form.

(D) Composition of Formula "A"

TABLE II

COMPOSITION OF FORMULA "A"

content	per cent
puree	72.00%
water	5.72%
sugar	20.85%
stabilizer	.57%
salt	.06%
Total	100.00%

This formula was used in all the following desserts unless otherwise stated. This formula was adapted because it is essentially that recommended by the Western Regional Research Laboratory of the U. S. D. A. It contains mostly fruit and only enough water to dissolve the stabilizer.

(E) Comparison of Overruns of Desserts Made by Using Various Stabilizers.

The amount of stabilizer used in the desserts below is the maximum amount one would likely use. In some states (7) a limit of 0.5% percent is set to be used in ice cream. Ice cream does usually contain from 0.25 to 0.5 percent of the stabilizer.

TABLE III

COMPARISON OF OVERRUNS OF DESSERTS BY USING DIFFERENT STABILIZERS

Stabilizer	Percentage Present	Overrun	Rating
Methocel	.57%	126%	1
Vestirine	.57%	117%	2
Gelatin	.57%	109%	3
Vel-o-teen	.57%	80%	4
None	—	57%	5
Cornstarch	.57%	43%	6
Pectin	.57%	40%	7
Amioca	.57%	38.5	8
Clearjel	.57%	38%	9
Krim-Ko Gel	.57%	37%	10

The above table indicates that Methocel has the

highest overrun of 126%. This is actually more than is desirable as in the above case a product was produced which had too much air incorporated, had a foamy texture and consequently had less flavor. Overruns of about 100 to 110 percent are most recommended. Therefore Vestirine, gelatin and Methocel when used in smaller amounts will satisfy those conditions. On the other hand the other stabilizers do not give enough overrun even when used at their maximum concentrations.

At this point it was not possible to say which of the stabilizers was the best one, Methocel, Vestirine, or gelatin. Other important features to consider besides the overrun for a stabilizer are the ease of handling, melt down characteristics of the dessert, the taste and the storage stability.

(F) Convenience of Using the Various Stabilizers.

For gelatin and Vestirine the puree should be raised to a temperature of about 70°F. before the stabilizer solution can be added. In case this precaution is omitted, clumps are formed which are hard to get rid of.

For Methocel desserts, the puree has to be only slightly above the freezing point when the Methocel solution is added. This means that much time and labor is saved when this stabilizer is used.

It is necessary to use hot water in order to dissolve the gelatin. This is not necessary in the case of the Methocel; however hot water does hasten the process.

Methocel is therefore easier to handle than the other stabilizers. Gelatin comes second of the better stabilizers. Vestirine as has been previously mentioned, is a mixture of gelatin and gums. When dissolved it tended to separate into its components and insoluble particles separated out. Because of this property and since it seemed to have no advantage over gelatin not much further research was conducted with this stabilizer.

(G) Melt-down Characteristics of the Desserts.

The desserts containing the three best stabilizers one at a time, did hold up very well at room temperature. Again Methocel was the leader, next came gelatin and third Vestirine.

The results of the experiments are summarized in the following table.

TABLE IV

GENERAL COMPARISON OF THE BETTER

STABILIZERS FROM TABLE III

Stabilizer	Ease of use order	Overrun	Meltdown characteristics	Quantity Used
Methocel	best	126%	best	.57%
Gelatin	next	109%	next	.57%
Vesterine	last	117%	last	.57%

From the above table and discussion it can be seen that Methocel has the most promising characteristics of a stabilizer.

(H) Effect of Amount of Stabilizer upon the Overrun of Methocel and Gelatin Desserts.

For this experiment Methocel and gelatin were studied in various percentages in the desserts.

TABLE V

EFFECT OF THE QUANTITY OF THE STABILIZER

ON THE OVERRUN OF THE PUREE

Stabilizer Used	Quantity	Overrun
Methocel	.24%	55%
"	.47%	123%
"	.71%	131%

TABLE V continued

Stabilizer Used	Quantity	Overrun
Methocel	.94%	186%
Gelatin	.36%	108%
"	.72%	110%
"	1.08%	135%

From table V one can see that an increase in the quantity of the gelatin or Methocel stabilizer used results in a corresponding increase in the overrun. Less Methocel is required for a given overrun. The rate of increase is also different for the two stabilizers - being greater for the Methocel. Therefore in order to produce Methocel puree desserts of desired overruns the quantity of stabilizer used would have to be more closely supervised than in the case of gelatin puree desserts.

(I) Sucrose Replacement.

About one third of the sucrose originally used in the desserts was substituted succesively with corn sirup solids (Frodex), and corn sirup (Sweetose). Not much difference was found in the melt-down characteristics of the resulting desserts. As far as the texture is concerned, Sweetose had no apparent effect while Frodex increased the viscosity slightly.

The above results are in agreement with work done previously at other institutions on the same subject. (See Figure 1, page 19).

(J) Development and Composition of Formula "B"

Although the formula for making the puree desserts as adapted from the W. R. R. L. type formula proved satisfactory, attempts were made to improve it in Formula B. First of all the amount of stabilizer used was reduced below .5%, which as has been stated before, is the limit set by many states. Secondly, the ratio between the fruit puree and water was changed; less fruit and more water being used. The amount of sugar was practically unchanged.

TABLE VI

COMPARISON OF THE COMPOSITION OF FORMULAS "A" AND "B"

	Formula "B"	Formula "A"
Content:	Per cent:	Per cent:
Puree	64. %	72.00%
Water	15.22%	5.72%
Sugar	20.20%	20.85%
Stabilizer	.47%	.57%
Salt	.04%	.06%
Total	100.00%	100.00%

TABLE VII

COMPARISON OF THE OVERRUN BETWEEN FORMULAS "A" AND "B"

Stabilizer	Formula "B" overrun	Formula "A" overrun
Gelatin	120%	109%
Cornstarch	60%	43%
Vel-o-teen	71%	60%
Vesterine	107%	106%
Pectin	44%	38%
None	60%	57%

It was shown that by using a formula (Formula B) with a higher percent of water the overrun was increased. The texture and flavor of the boysenberry desserts so obtained were changed but very little.

(K) Use of Other Fruits in the Desserts.

In this experiment different kinds of fruit purees were used. The following fruits and vegetables were found desirable: peaches, cantalope, strawberries, and sweet potatoes.

Next peaches were used in combination with boysenberries, about one third peaches. The results were very encouraging. Boysenberry desserts are too rich and concentrated in flavor and slightly too acid to suit some

persons, while the blended product with peaches or apples produce a dessert with the fine flavor of the boysenberries but not so concentrated.

Therefore blending of fruits is probably a desirable procedure when fruits such as boysenberries are used.

(L) Taste Tests.

Preliminary taste tests were run on the various desserts made using different stabilizers in various quantities. The details are not included as they would take too much space while they can be briefly summarized:

1. The amounts of stabilizers used are so small that they could not be detected by taste.
2. With the increased percentage of the stabilizers Methocel or gelatin used, greater increase in volume was affected. Since there was then less fruit present in a given volume, there would also be slightly less fruit flavor. Overruns of 90 to 110 percent were favored by the majority of tasters.
3. The texture of various purees depended mainly on the kind and amount of stabilizer used, on the amount of overrun, and fruit used. The taste panel conducted for the comparison of different stabilizers when used in frozen fruit purees eliminated all but gelatin and Methocel.

The procedure for the taste panels was conducted according to Wiegand and Lorant (22, p. 1-2). The products were judged for (1) smoothness (opposite to graininess), (2) fluffiness, (3) general texture (which includes fluffiness, rubberiness, hardness, rigidity, etc.), (4) general acceptibility (flavor, texture, color, etc.).

(M) Storage Stability of the Puree Desserts.

The storage stability was tested at about 0°F. and also at 20°F., and at fluctuating temperatures between the two limits.

The results indicated that the storage stability is very good around 0°F. Samples packed in pint sized waxed paper cartons showing little if any deterioration in quality during a four month storage period. At 20°F. and fluctuating temperature, a stale oxidized flavor developed very rapidly.

TABLE VIII

COST OF THE RAW MATERIALS FOR THE

BOYSENBERRY PUREE DESSERTS

Material	Cost per lb.	Amount needed for a batch	Cost per batch
Boysenberry puree*	13 cents	1410 gms	41.1 cents
Sugar	10 cents	405 gms	9.0 cents
Gelatin**	110 cents	11 gms	2.7 cents
Total cost for one batch (6.5 pints of dessert)			52.8 cents
Total cost for one pint of dessert			8.1 cents

* There is a 90 percent yield of puree from the boysenberries which cost 12 cents per lb.

** Dow Methocel, 4000 cps, which could be used instead of the gelatin, was priced at 80 cents per lb. in May 1948.

SUMMARY AND CONCLUSION

The effects of ingredients and preparation procedures upon commercial type frozen fruit puree desserts were studied. As far as the ingredients are concerned it was shown that the kind and amount of stabilizer used plays a major role. Eleven different stabilizers were tested. Of these Methocel and gelatin gave the largest overrun, had the most desirable melting down characteristics and were also easy to use with these desserts.

Different fruits used gave very good products such as peaches, cantalopes, and strawberries, and especially boysenberries which were used in all experiments unless otherwise stated. Blending of fruits especially in the case of high acid, strong flavored fruits such as boysenberries was found desirable.

Substitution of sucrose by other sweetening agents has been tested on a limited scale, but the results did not show any definite improvement.

The formula was also changed as far as the quantity of individual ingredients were concerned. The Western Regional Research Laboratory type formula was used as a standard. First the amount of stabilizer used was tested at different levels. For Methocel the optimum quantity for boysenberry puree desserts was found to be around

.4 percent while gelatin around .5 percent by weight of the dessert. Secondly the percentages of fruit and water were varied. Experimental results indicated that by using 64 percent berry puree instead of 72 percent a dessert was obtained which had a similar texture but a larger overrun. In desserts containing highly flavored, very acid fruits such as boysenberries, more water could be added to replace the fruit than in the less flavorsome fruit desserts.

Taste panels which were run for the comparison of different stabilizers when used for frozen fruit puree desserts indicated clearly that gelatin and Methocel were preferred by the tasters. A slight majority of tasters preferred the later but since the results were very close and only a limited number of taste tests were run, it is not possible to say which dessert is better.

In four month storage tests at 0°F. there was very little loss in the quality of these desserts. These fruit desserts could therefore be sold directly from the freezing machine the same way as soft ice cream is sold, or they could be made up and sold from storage.

During the studies on the effect of ingredients and preparation procedures upon commercial type frozen fruit desserts a very promising dessert has been developed.

This dessert contains Methocel as a stabilizing agent which so far has not been reported used for this purpose.

As has been mentioned before Methocel compares very favorably with gelatin as to eating qualities of the dessert, while the later has been generally recommended as the stabilizer for frozen fruit desserts. In addition it was found that Methocel is easier to use than gelatin because it can be added to the mix which is at freezing temperature, while when gelatin is used, the mix has to be warmed to 70°F. Methocel has also better melt down characteristics.

POST SCRIPTUM

POSSIBILITIES OF FROZEN FRUIT DESSERTS

It is hoped that developing this frozen fruit dessert will popularize to a greater extent an item which so far has been used during the war in place of ice cream, which was scarce then, but has not become well known. It has a fresh fruit flavor and is a nutritious product which should appeal to the general public. It is also inexpensive to make. About eight cents a pint was the estimated cost of the raw materials of the boysenberry dessert made in this laboratory.

This dessert has certain advantages over ice cream for the people who watch their diet, as it contains much less calories than ice cream does (153 cals compared to 222 cals) and is high in vitamin content.

This product is also of great economic value. Large amounts of fruits go to waste every summer because of surpluses which can not be all marketed, or marketed at the most advantageous prices. Also much fruit is too dead ripe to be shipped, but if preserved promptly it will yield an excellent product rich in natural flavor and sweetness.

The preparation of the desserts is simple. On the large scale the mixes could be simply frozen in an ice cream freezer and sotred at 0°F. until desired for use.

BIBLIOGRAPHY

1. Anonymous. Amioca - a new domestic starch. New York, National Starch Products Inc., 1946. 15 p.

2. Anonymous. Frozen fruit purees open new market for frozen fruits. Ice and refrigeration 105: 125-126, Sept. 1943.

3. Anonymous. Regional laboratory launches high overrun dessert made with frozen purees and no milk solids. Food materials and equipment 4:3-4, July 1944.

4. Anonymous. Velva fruit the new frozen fruit dessert. The Food packer 25:60-64, May 1944.

5. Blumenthal, Saul. Food products. Brooklyn, N. Y., Chemical publishing Co., 1947. 986 p.

6. Cruess, William Verne. Commercial fruit and vegetable products. New York, McGraw-Hill book Co., 1937. 798 p.

7. Dahle, C. D. Analysis of stabilizers. Ice cream field 48:62, Oct. 1946.

8. Glazier, Lynn R. and Mack, Merrill J. Corn sirup solids improve frozen dairy products. Food industries 13:68-70, 114-115, June 1941.

9. Jacobs, Morris B. The chemistry and technology of food and food products. vol. 2, New York, Interscience publishers, 1944. 952 p.

10. Jacobs, Morris B. Synthetic food adjuncts. New York, D. Van Nostrand Co., 1947. 335 p.

11. Lange, Norbert Adolph. Handbook of chemistry. 6th ed. Sandusky, Ohio, Handbook publishers, Inc., 1946. 1767 p.

12. Lowe, Belle. Experimental cookery. 2d ed. New York, John Wiley & Sons Inc., 1937. 600 p.

13. MacArthur, Mary. Frozen fruit desserts. Canadian Food Industries, Oct. 1947.

14. Mantell, C. L. The water soluble gums. New York, Reinhold publishing corp., 1947. 279 p.

15. Merck & Co., Inc. Merck's index. 4th ed. Rahway, N. J., Merck & Co. Inc., 1930. 1242.

16. Sommer, Hugo H. The theory and practice of ice cream making. Madison, Sommer, Hugo H., 1932. 611 p.

17. Sorber, Daniel G. Frozen sliced and pureed fruits. Canner 94:16, Jan. 1942.

18. Sorber, Daniel G. Prefreezing apples and other fruits for desserts. Quick Frozen Foods 5:125, April 1943.

19. Tressler, Donald K. and Evers, Clifford F. The freezing preservation of foods. 2d ed. New York, The Avi publishing co., 1946. 932 p.

20. Turnbow, Grover Dean, Tracy Paul Hubert and Raffeto, Lloyd Andrew. The ice cream industry. 2d ed. New York, John Wiley and Sons. 1947. 654 p.

21. Western Regional Research Laboratory. Velva Fruit - a new frozen fruit dessert, U. S. D. A. A. I. C. -40. March 1946.

22. Wiegand, Ernest Herman and Lorant George John. Testing acceptibilitu of food products - taste test procedures. Oregon State College agricultural experiment station circular of information No. 446, Jan. 1949.

23. Wiegand, Ernest Herman and Miller, W. J. New and improved berry products. Oregon Agricultural Experimental Station, Department of Food Industries. July 1938. 24 p.