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COMMERCIAL CANNING OF FRUIT PIE FILLINGS

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nmerland, B.C.

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COMMERCIAL CANNING OF FRUIT PIE FILLINGS

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INTRODUCTION

Canned ready-to-use fruit pie fillings are not new products having been on the market since about 1946. However, there has been a tremendous variation in the quality of the product resulting in irregular acceptance by consumers. The object of this bulletin is to present information about the manufacture and storage of high-quality fruit pie fillings. Studies reported here deal with fillings with a high content of fruit, various stabilizers, and the behavior of these fillings under a wide range of storage conditions. Commercial packs using formulae and methods presented in this publication have been accepted well by consumers.

ADVANTAGES OF CANNED FRUIT PIE FILLINGS

1. Canned fruit pie fillings reduce the work involved in the preparation of pies, and fillings for cakes. They also may be used as flavoring for ice cream, or as fruit desserts.

2. Fruit pie fillings provide an additional item for the canner's list of products.

3. Some processors can use in pie fillings fruit that would otherwise be canned as Standard grade. The canner then finds it easier to market Fancy and Choice grades.

4. Fllings make possible an extended canning season, since they can be prepared from frozen and previously canned fruits, as well as fresh fruit.

5. Plant overhead is distributed over a longer period of the year.

DESIRABLE CHARACTERISTICS

The major characteristics of a high-quality canned fruit pie filling are as follows:

1. Large pieces of fruit should be retained where practical.
2. The filling should be of the characteristic color and flavor of the fruit from which it is made.
3. The product should have as high a fruit content as is consistent with texture, flavor and general appearance. Fruit contents up to 80 per cent have been found practical.
4. The gel phase should be stabilized with the smallest amount of thickener that will give the desired set.
5. The filling should be bright and attractive.
6. The product should be heat-sterilized in sanitary cans. Chemical preservatives are not justified.
7. The filling should be of uniform composition.

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FRUITS AND VARIETIES

Fresh and frozen fruit are the normal sources of raw material and produce the best product. Maturity and condition generally are more important than variety, although in some cases the differences among varieties do affect quality. A wider range of tree fruits can be used in pie fillings than in conventional canning since keeping the shape of the pieces is much less important.

Processing fruit into pie filling is intended as an additional outlet for good-quality fruit. Generally the use of culls is impractical because of the need for more labor to handle them. The type of pie filling discussed in this bulletin would not provide a way to salvage low-quality fruit.

Fruits, and varieties where known, together with facts about their suitability for producing high-quality pie fillings are as follows:

Tree Fruits

Apples

Excellent:	Jonathan
Good:	McIntosh, Wealthy, Stayman, Winesap, Newtown, Rome Beauty
Poor:	Delicious

Apricots

Excellent:	blend of equal parts of Perfection and Wenatchee Moorpark
Good:	Blenheim, Royal, Tilton

Prune Plums

Excellent:	(if soluble solids exceed 18 per cent) Italian Prune, late and early strains, Demaris or Greata

Peaches

Excellent:	Veteran, Valiant, Vedette
Fair:	J. H. Hale, Elberta (blend of equal parts of these two varieties is superior to either used alone)

Sour Cherries

Excellent:	Montmorency

Berries

Blackberries

Good:	Varieties unkown

Black Currants

Excellent:	Boskoop Giant

Blueberries

Excellent:	June, Stanley, Berkeley
Good:	Dixi, Wareham, Atlantic, Weymouth, Coville, Rubel, Rancocas, Blue Crop, Pemberton

Loganberries

Excellent:	Varieties unkown

Raspberries

Excellent:	Washington, Willamette
Fair to Good:	Newberg

Strawberries

Good:	British Sovereign

With some kinds of fruits variety may not be an important quality factor, but with others, such as apples, apricots, peaches and raspberries marked variation in quality can be due to variety.

Apples—Jonathan is outstanding for retaining its shape, texture, color and flavor. All the other varieties, excluding Delicious, give fillings of good quality. Delicious needs acidification with about 0.35 per cent citric acid to make a satisfactory product. This variety is useful, however, in blends with a berry fruit such as black currant, raspberry, blackberry, loganberry and blueberry.

Apricots—Satisfactory fillings can be made from any of the apricot varieties tested. However, a blend of equal parts of Perfection and Moorpark results in the best product for color and flavor.

Peaches—Excellent pie filling can be made from the varieties Veteran, Valiant and Vedette. Those made from J. H. Hale and Elberta, although satisfactory, are of decidedly poorer quality. A blend of equal parts J. H. Hale and Elberta results in a better filling than either variety alone.

Raspberries—Fillings made from Washington and Willamette raspberries are of better quality than those made from Newberg. The first two varieties have a much richer, dark red color and a more pronounced raspberry flavor than Newberg.

STABILIZING AGENTS

The type and amount of stabilizer used in a pie filling influences the degree of set and consistency of the finished product. It is generally considered that pies, especially berry pies, should spread or weep slightly as illustrated in Figure 1.

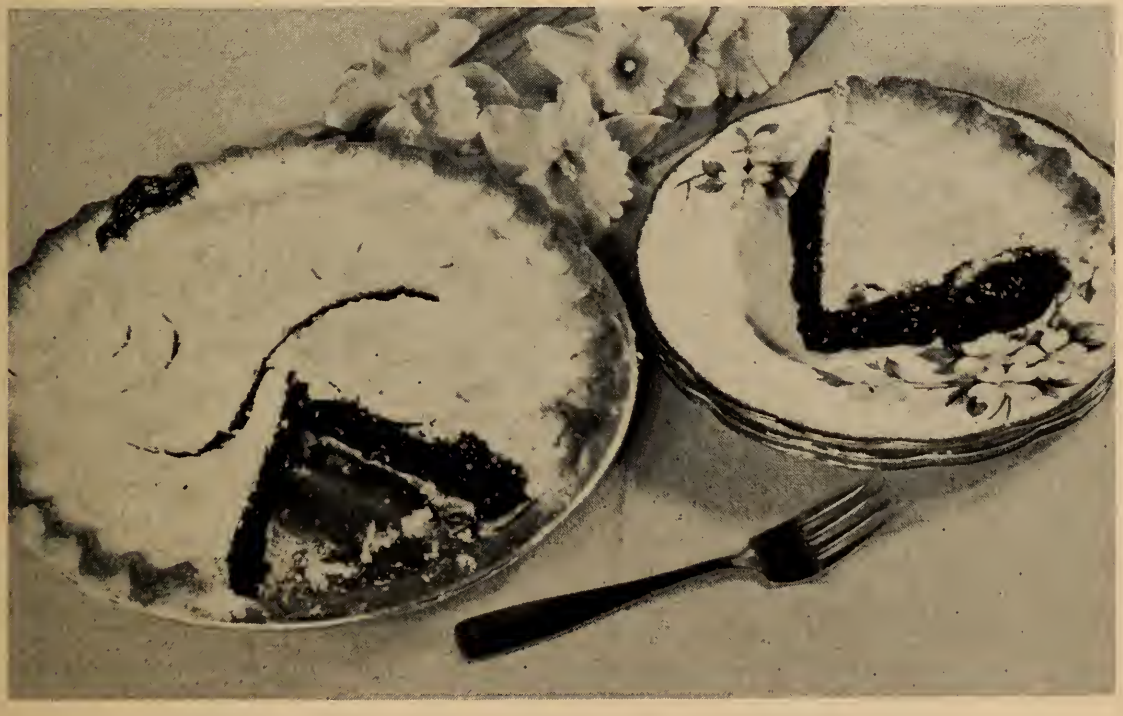

Figure 1. A perfect berry pie made from high-quality filling.

Many thickening agents may be used, the selection being governed by a number of factors. Some are undesirable because the resulting product is either too gummy, sets too firmly, is cloudy, or off-flavor. Other stabilizers break down during canning or storage. Some have both desirable and undesirable characteristics depending upon the concentration in which they may be used. Others cost too much.

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The type and quantity of stabilizer required varies with the kind of fruit. Few are satisfactory when used alone, the best results being obtained by a combination of two or more. Those found most satisfactory are included in the formulae for making the various fruit fillings (see pages 17 to 22).

Starches

A long-boiling starch, such as ordinary corn starch, is unsatisfactory because the excessive cooking required to make the starch soluble results in too much breakdown of the fruit and produces a cloudy starch gel. Pie Baker's starch, a slightly improved form of corn starch, takes a boiling time of about six minutes. Both these starches may break down during processing or storage, especially if not boiled enough or if the pH is not correct.

New improved pregelatinized, modified, or specially tailored starches requiring only 30 seconds to one minute at the boil, or which form stable colloidal solution at temperatures below boiling, are much more satisfactory for use in fruit pie fillings. The short heating time results in brighter fillings and better flavor retention.

Root starches, such as tapioca, are generally superior to the cereal starches for clarity, flavor and stability. An objection to the usual forms of granular tapioca is the presence of tapioca 'pearls' in the finished product. Use the smaller granular tapiocas such as -20 or -40 mesh to overcome this problem. Tapioca flour is too fine and results in a glutinous, unsatisfactory product.

Pectins

Low-methoxyl (L.M.) pectins can be used to advantage in products of a glutinous nature such as apricot. The gel phase remains clear and attractive and does not impart an off-flavor to the product. Low-methoxyl pectins do not require sugar for gel formation and will form gels over a wide pH range (2.5 to 6.5). Fillings containing L.M. pectins remain exceptionally stable in low-temperature storage.

Derivatives of Irish Moss

Derivatives of Irish Moss (Carrageenin) materially lower viscosity during cooking, resulting in better, more uniform heat penetration. They tend to impart a brightness to the product and a favorable texture. Although unaffected by heat, derivatives of Irish Moss are markedly affected by pH which must be above 3.5 and preferably around 3.7. In many canned fruit pie fillings they produce an off-flavor. This is particularly noticeable with peaches and apricots in concentrations as low as 0.05 per cent.

Algin derivatives, extracted from the giant kelp of California, such as Keltose, Kelgin and Kelcosol have proved satisfactory in sour cherry pie fillings. With this fruit, it is possible to reduce starchy stabilizers 25 per cent by adding 0.3 per cent of one of the above algin products.

Carbohydrate Gums and Derivatives of Cellulose

In small amounts (0.1 per cent) locust bean gum or carboxymethyl-cellulose preparations are desirable ingredients in combination with other thickeners. They impart a brightness to the product and absorb most of the free-running liquid. They are undesirable in concentrations above 0.3 per cent because of excessive viscosity. Their thickening ability is not noticeably affected by process temperatures or pH and they remain reasonably stable in the stored product.

PROCESSING METHODS

Fillings can be prepared by using either a batch process or continuous operation. With fruits such as apples, apricots and peaches the batch process results in better appearance and quality because there is less breakdown of fruit pieces. The chief objection to a batch process is that output is less for the additional labor needed. However, by using a series of kettles and a good operating schedule, volume production can be obtained with a lower investment.

Batch Process

Stone Fruits and Berries

With this method use as little water as possible. Total heating time should not exceed six minutes. In general, add thickeners toward the end of the heating process. Fill product into cans at sterilizing temperatures of 190 to 200°F. No further cooking will be necessary. Invert the cans to sterilize the lids and immediately cool in water to 100 to 105°F.

One-hundred-pound batches are considered ideal, although one could use larger batches of berries if it is not important to retain pieces of whole fruit. It is essential to keep the steam pressure on the kettle at least 50 lb. per square inch, preferably 60 to 70 lb., to ensure quick cooking and retain as much color and flavor as possible. Effective removal of condensed steam from the kettle is necessary for quick heating.

Flow sheets for apricot, peach, prune plum, sour cherry, berry and berry-apple fillings are given in Figures 2 and 3.

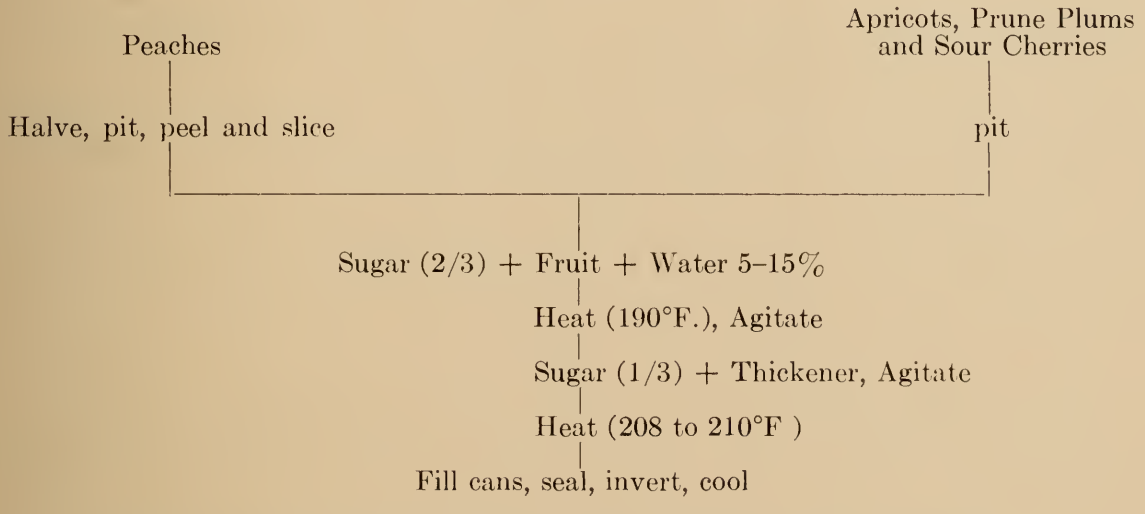

Figure 2. Flow sheet for apricot, peach, prune plum and sour cherry canned fruit pie fillings.

Prepare peaches by halving, pitting, peeling and slicing into sections about ½ inch thick. Prunes, sour cherries and apricots are pitted. With apricots, peaches and prunes the best product results from hand-pitted fruit but higher costs might make machine pitting necessary for volume production. With these fruits the addition of a small portion of hand-pitted fruit will markedly improve the appearance of the finished product.

Apple sauce can be used to advantage for making sour cherry and some of the berry pie fillings. Its use enables a processor to use less of the more expensive fruits without seriously affecting quality. In addition, it reduces the amount of stabilizer needed to set the product. Apple sauce, however,

should not exceed 35 per cent of the total fruit content; a higher percentage generally will impart an apple flavor to the product and materially weaken the fruit color.

Place the prepared fruit or fruit and apple sauce and one half to two thirds of the sugar in a stainless steel kettle and add a small amount of water. Usually 10 to 15 lb. of water added per 100-lb. batch is enough to prevent burning during the initial heating and helps to quickly release the juice from the fruit. With frozen fruits the addition of water is not necessary, since there is enough liquid present from the thawed product to accomplish the same purpose. The added water will be removed by the heat treatment that follows.

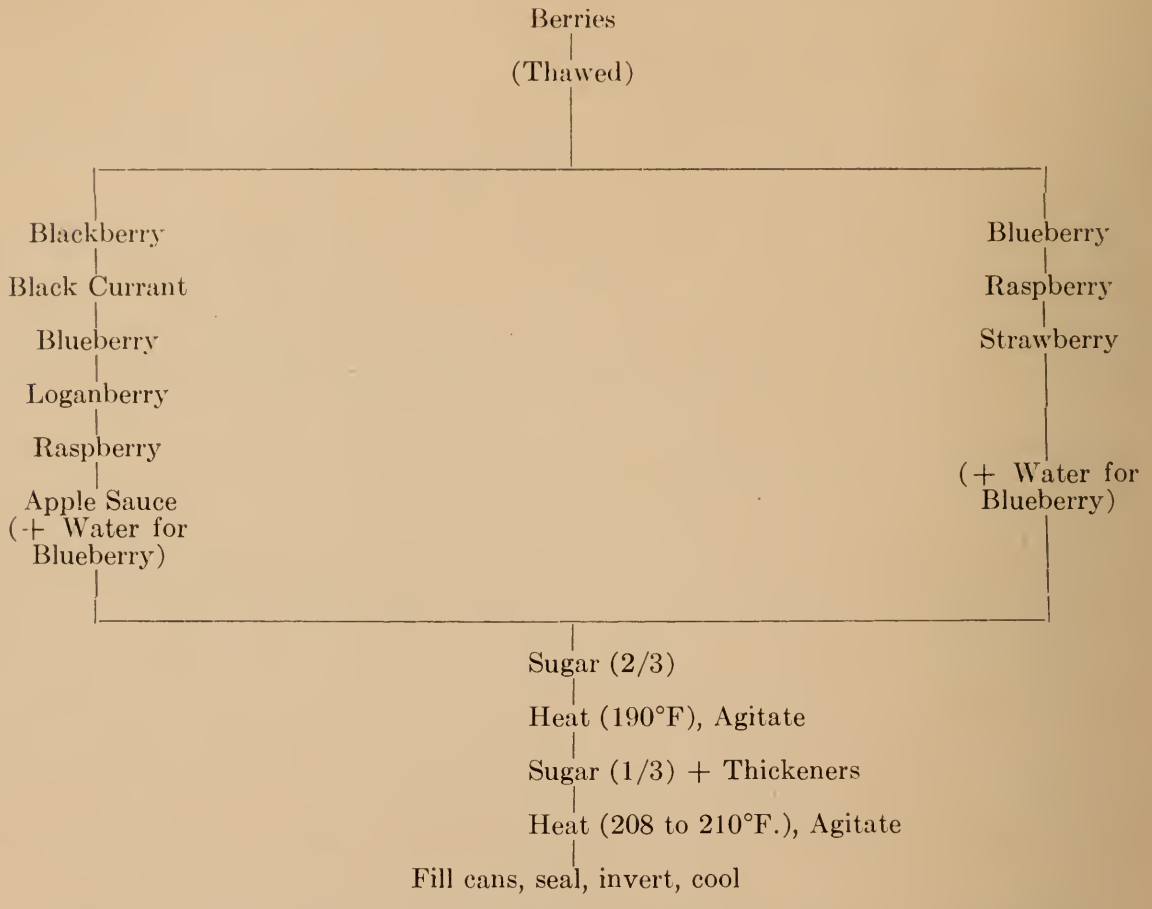

Figure 3. Flow sheet for berry and berry–apple canned fruit pie fillings.

If the frozen fruit contains sugar, make allowances for this when calculating ingredients in the formula. Quickly heat the batch to 190°F., which should not take longer than three to four minutes, and agitate continuously. Only a small proportion of the fruit should be broken to form the continuous phase with the thickener. When a temperature of 190°F. is reached, add the balance of the sugar containing the thickener. Sift in this sugar–thickener mixture while the batch is being stirred and continue heating to 208 to 210°F., which usually takes one to two minutes. The gases in the large pieces of fruit should have been eliminated at this point.

Fill at 190°F. or higher. Invert the cans after capping and immediately water cool to 100 to 105°F. The *total heating time for the batch should not exceed five to six minutes.*

Variations Using L.M. Pectin

When using low-methoxyl (L.M.) pectins, include sodium citrate, citric acid and calcium chloride in the formulations to obtain a satisfactory set. The calcium salt supplies the divalent calcium ions necessary for the ionic cross

linkage of adjacent pectinate chains. Most fruits do not contain enough natural calcium salts to provide the low-methoxyl pectin with all of the ions it needs for gelation. The sodium salt is added to provide monovalent metallic ions which will interfere momentarily with the rapid cross linkage between the free carboxyl groups of the pectinates and the calcium ions. Thus the low-methoxyl pectins dissolve better in the presence of calcium, and sometimes a better ultimate gel will result when a salt such as sodium citrate is present in low concentrations.

Using formulae employing low-methoxyl pectins, modify the foregoing batch process as follows:

Heat the sodium citrate, citric acid, calcium chloride solution and a portion of the water in a stainless steel kettle to 200°F. Disperse the L.M. pectin in one third of the sugar, add to the above and dissolve at 200°F., stirring constantly. Add to the kettle the thawed fruit, or prepared fruit and water, together with another third of the sugar and heat the mixture to 210°F. for one to two minutes. When additional stabilizers are needed, disperse them in the remainder of the sugar, add to the mix and carry out the rest of the process as previously outlined.

A variation of the L.M. pectin process resulting in a slightly lighter set can be obtained by omitting the addition of calcium chloride solution. In this modification, dissolve the sodium citrate and citric acid in part of the water without heat. Add these ingredients to the batch after the fruit–sugar mix has come to a boil and before adding the stabilizing ingredients dispersed in the remainder of the sugar.

Apples

The process as outlined for stone fruits is unsatisfactory for apples. Apple tissue browns rapidly in the presence of air. The entrapped gases are not easily removed during heat treatment alone and prolonged heating results in a breakdown of the fruit into apple sauce. An apple pie filling containing a high percentage of whole slices is obtained by vacuum treating[1] a portion of the sliced fruit and blending it with previously prepared apple sauce. Mix one part of apple sauce with three parts of vacuum-treated sectors and one part of sugar containing the thickeners. The apple sauce should not exceed 25 per cent of the total fruit content. In using a continuous process it is not necessary to add sauce since enough apple slices will break down during processing.

Figure 4, outlines the process suggested for apples. Peel and core, and trim the fruit into tanks containing a 2 to 3 per cent salt brine; the brine prevents tissue browning. Rinse the slices in cold water to remove all traces of salt prior to processing. Mix the fruit for the apple sauce with 30 per cent water and approximately three quarters of the total amount of sugar. This mixture is made into apple sauce, either by boiling in a stainless steel kettle, or by passing through a continuous apple sauce machine. If preferred, add the sugar to the prepared apple sauce.

Slice the fruit for vacuumizing into sectors not exceeding $\frac{1}{2}$ inch thick. Treat the sectors with a vacuum of at least 27 inches for about six minutes, releasing the vacuum with steam or hot water. Add the treated sectors to the hot applesauce. Add the rest of the sugar with the thickeners dispersed in it. Heat the mixture to 208 to 210°F. and fill hot (190 to 200°F.) into sanitary containers. After sealing invert the cans and immediately water cool to 100 to 105°F.

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[1] Described later in this bulletin.

If heating takes longer than five to six minutes and there is excessive breakdown of apple sectors, modify the process as follows: Heat the apple sauce to 190°F. Add two thirds of the required sugar and reheat to 190°F. Add the apple sectors to the mass and reheat to 190°F. then add the rest of the sugar containing the stabilizers, agitating constantly. Heat the entire contents of the kettle as rapidly as possible to 208 to 210°F. before filling, closing and subsequent cooling.

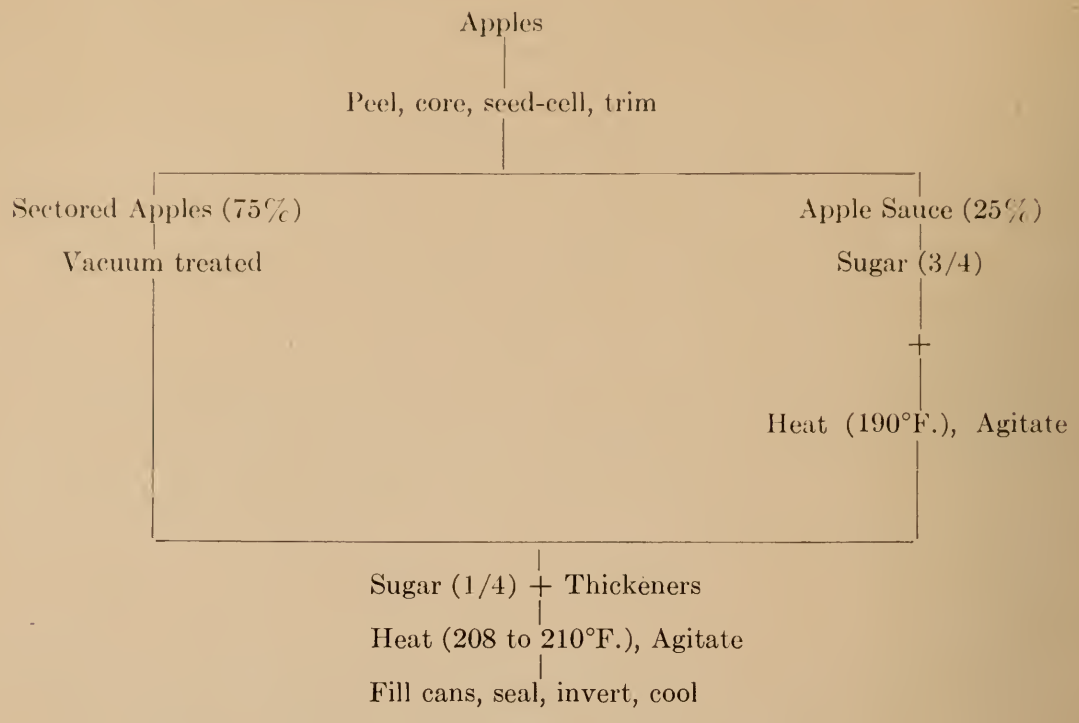

Figure 4. Flow sheet for canned apple pie filling.

Continuous Process

Continuous-mixing cookers have been developed by several companies. These cookers are essentially a steam-jacketted trough containing a screw conveyor. The screw may or may not be steam heated. The fruit is fed into the cooker by a conveyor and the other ingredients added continuously by various means. Continuous processing makes possible large-scale production at low cost but does lower the quality by breaking down pieces of fruit to some extent. In another method of obtaining a continuous process, but with which the writers have had limited experience, the fruit is added directly to the can. A partially gelatinized starch slurry, containing the remaining ingredients such as sugar, water, etc., is added through a syruping machine. The cans are then sealed under vacuum and cooked in a continuous retort process. This method requires a retort or continuous-agitating cooker and produces a product in which the fruit is set in a clear gel. It is stated that a less expensive type of starch can be used in this product. However, heat penetration is very slow and enough cooking to sterilize and stabilize the product tends to result in off-flavors and off-colors. From the preliminary work conducted in the Summerland Laboratory the product made by this method is not considered so desirable as that produced by the complete cooking of the product before it is filled into the cans.

A process that is used to a limited extent involves the separate cooking of both the fruit and starch-base portions of the mix. These two are then combined in the can and shaken vigorously to ensure a homogenous appearance.

This system is not entirely satisfactory since the amount of agitation necessary to produce a homogenous appearance in the can cannot be obtained with the small headspace that is available. (Mixing the two portions just before filling into the can might be feasible with certain fruits).

TESTING QUALITY

The quality of the finished product should be checked in the pie, especially when the formula has been modified or a stabilizer substitution made. Quite often fillings that appear a trifle thin or too thick, on removal from the container, result in highly satisfactory pies. On the other hand, fillings of seemingly ideal consistency sometimes prove unsatisfactory after baking.

One 20-ounce can contains enough filling to make an 8-inch standard two-crust pie. Empty the can contents into a prepared pie shell, adjust the top crust and bake at 425°F. for 30 to 35 minutes. The pie should be allowed to cool before cutting for organoleptic examination.

ADDED COLOR

Generally it is not necessary to add color if good sound fruit is used, processed properly, and stored at temperatures below 70°F. The probable exceptions are some of the berry fruits and sour cherries. With these fruits accepted food colors can be added which tend to improve the appearance of the product. A dye consisting of 2 parts Ponceau SX and 1 part Amaranth used at $\frac{3}{8}$ ounce per 100-lb. batch, imparts a very attractive color to sour cherry fillings. The color retention in strawberry pie fillings stored at 70°F. can be markedly improved by adding 1.5 to 2.25 per cent cranberry concentrate (36 per cent solids); do not add more than 3.0 percent because higher concentration will affect the flavor.

CHEMICAL COMPOSITION

The soluble solids content, as determined by refractometer, and pH of fruit pie fillings varies with the kind of fruit and amount used. Representative samples of the various fillings prepared from formulae recommended in this

TABLE 1—Soluble solids and pH of canned fruit pie fillings

Fruit		Soluble Solids*	pH**
Kind	%	%	
Tree Fruits			
Apple	80	30–35	3.20–3.93
Apricot	80	30–35	3.53–4.17
Italian Prune	80	36–40	3.41–3.50
Peach	80	30–35	3.54–3.72
Sour Cherry	75	30–35	3.34–3.41
Berries			
Blackberry	80	32–34	3.48–3.61
Black Currant–Apple	70	41–44	3.07–3.20
Blueberry	55–67.5	30–35	3.14–3.36
Loganberry	75	36–40	3.10–3.15
Raspberry	75–80	30–35	3.04–3.21
Strawberry	75–80	32–36	3.43

* Soluble solids determined directly on the equalized filling by a Zeiss industrial-model refractometer graduated with a sugar scale standardized at 20°C. (68°F.).

** pH determined directly using a Beckman glass electrode pH meter.

publication were analysed (see Table 1). The values indicate the degree of variability one would normally find when preparing these fillings. In all cases, except for blackberry and strawberry fillings, determinations were carried out on at least 12 samples.

STORAGE

One should store canned fruit pie fillings at temperatures below 70°F. to obtain a satisfactory shelf life.

At storage temperatures above 70°F. quality loss is due chiefly to color and flavor changes. This is especially true of blackberry, loganberry, raspberry, strawberry and sour cherry fillings. Generally there is little evidence of stabilizer breakdown at these temperatures.

Color and flavor are best retained at storage temperatures below 40°F. with maximum retention occurring at 0°F. Quality loss at cold storage temperatures results mainly from thickener breakdown and syneresis. At 0°F. syneresis is not serious, but in some berry and berry–apple fillings there is a tendency for considerable liquid to separate during extended storage. This liquid separation is accompanied by a desiccated appearance in the product itself. Coagulation developing during storage at 0°F. to 40°F. is not reversible at ordinary temperatures (70°F.); the thickeners, however, at baking temperatures do redissolve resulting in pies of good consistency.

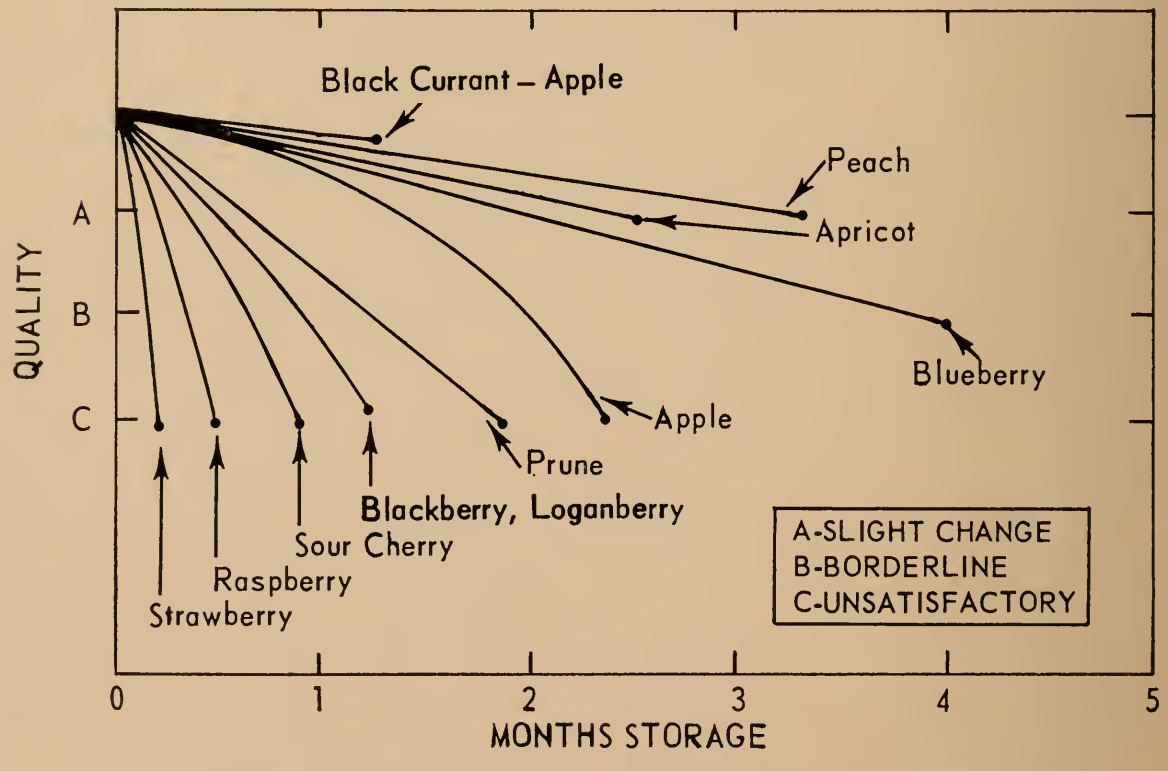

Figure 5. Storage life of canned fruit pie fillings held at 100°F.

Graphs to show the shelf life of canned fruit fillings stored at 100, 85, 70, 40 and 0°F. appear in Figures 5 to 9. Quality observations were based on color, flavor retention and stability. The scale is an arbitrary one but the resulting curves give a reliable indication of storage life of the different fillings. Longest storage life compatible with acceptable quality occurs in the neighborhood of 'borderline' on the graphs.

At 100°F. the storage life of all fillings is extremely short (see Figure 5); less than four months for black currant–apple, apple, peach, apricot and blueberry, and less than two months for other fruits. Prune, blackberry–apple, loganberry–apple, sour cherry and especially raspberry and strawberry become unacceptable very rapidly at this temperature.

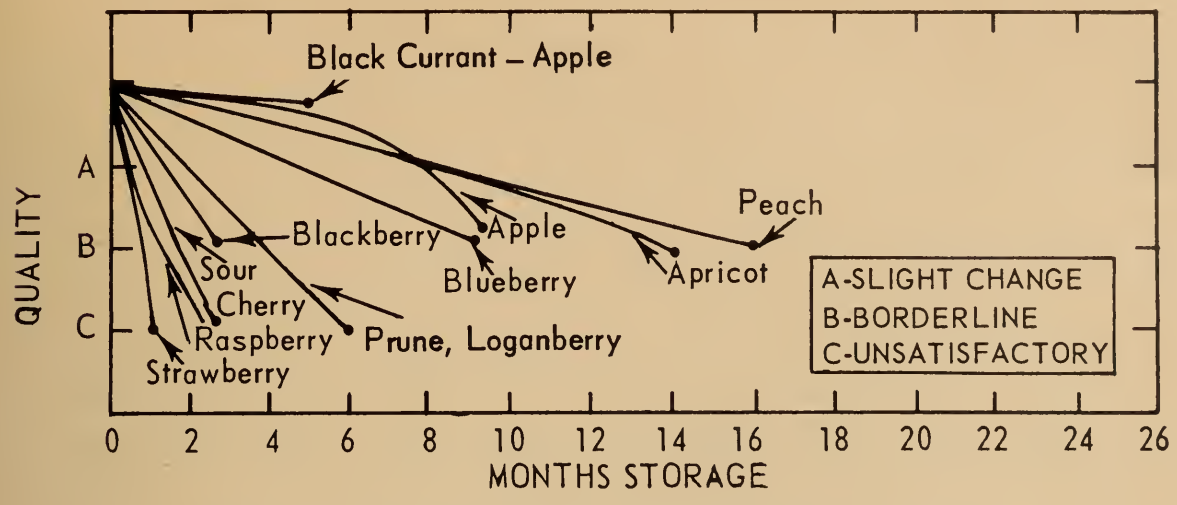

Figure 6. Storage life of canned fruit pie fillings held at 85°F.

Quality loss at 85°F. (see Figure 6) is not so rapid as at 100°F. Peach, apricot, apple, blueberry and probably black currant–apple fillings are still of fairly good quality after 9 to 15 months storage. The storage life of strawberry, raspberry and sour cherry at 85°F. is poor, ranging from three to eight weeks.

After 16 months storage at 70°F. (see Figure 7) apricots, black currant–apple, apple and peach fillings were still of excellent quality. Even after two years the latter two fillings were of very good quality. Sour cherry, strawberry and raspberry fillings, however, were only borderline acceptable after four months storage.

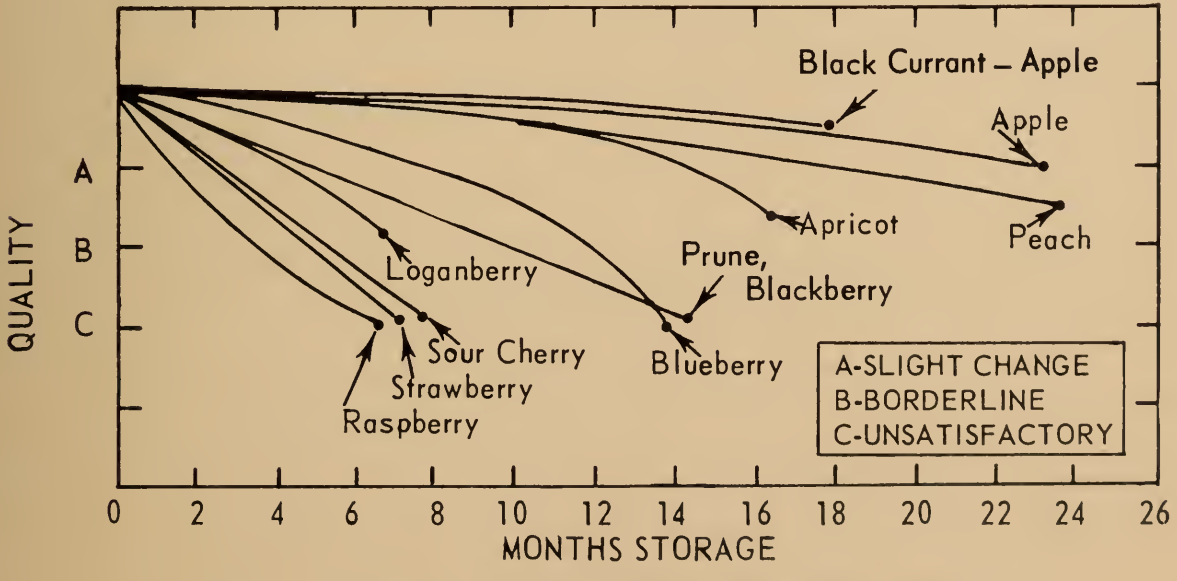

Figure 7. Storage life of canned fruit pie fillings held at 70°F.

All fillings, except sour cherry (stabilized with starchy thickening agents), can be held at 40°F., (see Figure 8) for periods exceeding 12 months without serious loss in quality. With sour cherries unacceptability is due to thickener

coagulation which also occurs but to a lesser degree at 0°F. storage. However, the use of low-methoxyl (L.M.) pectin as a stabilizer in sour cherry fillings has resulted in a product which is more stable in cool temperature storage than those using only starchy stabilizers. For example, at 32°F. samples containing L.M. pectin have shown no thickener coagulation after 70 weeks storage; those containing only starchy stabilizers showed considerable coagulation within 10 weeks.

Apricots and black currant–apple, after 16 months, and apple and peach, after 24 months storage at 40°F. were almost the equivalent of fresh pie fillings. Quality deterioration in raspberry fillings is most rapid during the first four months. From then on it is more gradual, the product becoming borderline in approximately 18 months.

Results of experiments at 32°F. closely parallel those of storage tests carried out at 40°F.

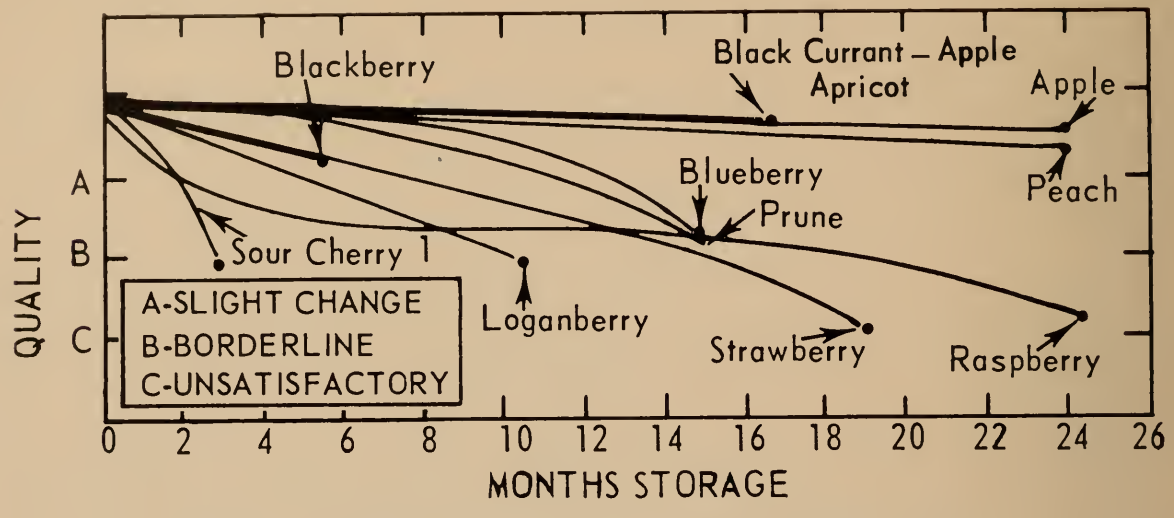

Figure 8. Storage life of canned fruit pie fillings held at 40°F.
[1] Stabilized with starchy thickening agents.

Maximum quality retention in canned fruit pie fillings is obtained at 0°F. storage (see Figure 9). With the exception of sour cherry (containing starchy stabilizers only) the fillings were still highly acceptable after 13 months. Indications are that all fillings except sour cherry, strawberry, loganberry and possibly raspberry exhibit little loss in quality up to 18 months at this temperature.

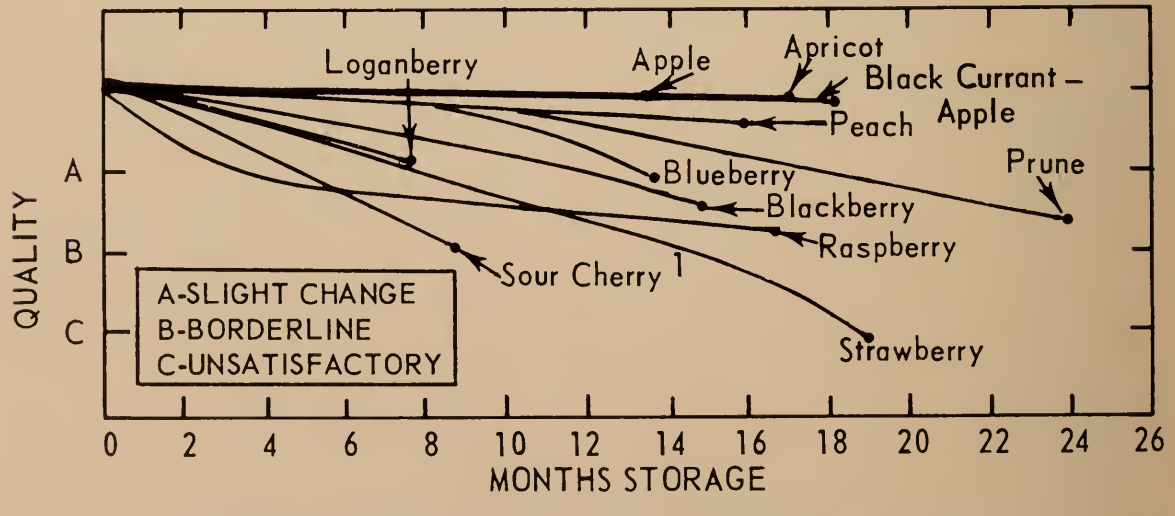

Figure 9. Storage life of canned fruit pie fillings held at 0°F.
[1] Stabilized with starchy thickening agents.

FORMULAE

The formulae that follow have all been thoroughly tested at the Summerland Fruit Processing Laboratory. In instances where several formulae are included under the same fruit, it should be noted that the resulting fillings were considered of equal quality. A selection is given to enable a processor to make the best possible use of stabilizers and other ingredients he might have on hand, or can readily obtain.

All ingredients must be of 'food grade', U.S.P. or B.P.

Trade names have been used of necessity to refer to specific commercial preparations; other products not tested may be equally satisfactory.

Apple Filling Formulae

(Approximate soluble solids content of finished product 30 to 35 per cent)

Ingredients	No. 1		No. 2		No. 3	
	lb.	oz.	lb.	oz.	lb.	oz.
Fruit (75% sectors, 25% sauce)	80	—	80	—	80	—
Sugar	20	—	20	—	20	—
Locust bean gum	—	3¼	—	1½	—	1½
Amaizo W-13 Stabilizer or Snow Flake Starch No. 4828	—	—	—	8	—	—
Minute tapioca (regular)	—	—	—	—	—	4
Snow Flake Starch No. 4828 or Amaizo W-13 Stabilizer or Arrowroot starch	—	—	—	—	—	4

Apricot Filling Formulae

(Approximate soluble solids of finished product 30 to 35 per cent)

Ingredients	No. 1		No. 2		No. 3	
	lb.	oz.	lb.	oz.	lb.	oz.
Fruit	80	—	80	—	80	—
Sugar	20	—	20	—	20	—
Locust bean gum	—	1½	—	1½	—	—
Minute tapioca (regular)	—	10	1	8	—	—
Minute tapioca (−20 mesh)	—	10	—	—	—	10
L.M. Pectin No. 466	—	—	—	—	—	6
Sodium citrate	—	—	—	—	—	5
Citric acid*	—	3	—	3	—	1½
Calcium chloride solution**	—	—	—	—	14 fl. oz.	

* Not required with Perfection-Moorpark variety blends. Usually 1½–3 oz. per 100 lb. batch required with other varieties.

** Prepared from calcium chloride hydrate ($CaCl_2.2H_2O$) at 22.45 g. per liter (3.6 oz. per gal.) of water.

Sour Cherry and Sour Cherry–Apple Filling Formulae

(Approximate soluble solids content of finished product 30 to 35 per cent)

Ingredients	No. 1		No. 2	
	lb.	oz.	lb.	oz.
A. Sour Cherry				
Fruit	75	—	75	—
Sugar	25	—	25	—
Locust bean gum	—	1½	—	—
Minute tapioca (−40 mesh)	1	—	—	6½
Amaizo W-13 Stabilizer or Snow Flake Starch No. 4828	1	—	—	6½
L.M. Pectin No. 466	—	—	—	8
Sodium citrate	—	—	—	2¼
Dye*	—	⅜	—	⅜
*B. Sour Cherry–Apple Blend***				
Fruit—Sour cherries	67	8		
Apple sauce	7	8		
Sugar	25	—		
Locust bean gum	—	1½		
Minute tapioca (−40 mesh)***	—	8		
Amaizo W-13 Stabilizer*** or Snow Flake Starch No. 4828	—	8		
Dye*	—	⅜		

* Dye consists of 2 parts Ponceau SX and 1 part Amaranth.
** This blend is equal in flavor, color and appearance to the all-sour-cherry filling.
*** If apple sauce made from summer apples use 12 to 16 oz.

Peach Filling Formulae

(Approximate soluble solids content of finished product 30 to 35 per cent)

Ingredients	No. 1		No. 2		No. 3	
	lb.	oz.	lb.	oz.	lb.	oz.
Fruit	80	—	80	—	80	—
Sugar	20	—	20	—	20	—
Locust bean gum	—	1½	—	1½	—	—
Minute tapioca (regular)	1	2	—	—	—	—
Minute tapioca (−20 mesh)	1	2	1	8	—	—
Minute tapioca (−40 mesh)	—	—	—	—	1	3½
Amaizo W-13 Stabilizer or Snow Flake Starch No. 4828*	—	—	1	—	—	—
L.M. Pectin No. 466	—	—	—	—	—	8
Sodium citrate	—	—	—	—	—	2¼
Citric acid	—	3	—	3	—	3½
Calcium chloride solution**	—	—	—	—	15 fl. oz.	

* Pregelatinized arrowroot or Redigel (pregelatinized wheat starch) may be substituted here with reasonable satisfaction.

** Prepared from calcium chloride hydrate ($CaCl_2.2H_2O$) at 22.45 g. per litre (3.6 oz. per gal.) of water.

Prune Plum Filling Formulae

(Approximate soluble solids content of finished product 36 to 40 per cent)

Ingredients	No. 1		No. 2		No. 3	
	lb.	oz.	lb.	oz.	lb.	oz.
Fruit	80	—	80	—	80	—
Sugar	20	—	20	—	20	—
Locust bean gum	—	1½	—	1½	—	—
Minute tapioca (regular)	1	—	1	8	—	—
Minute tapioca (−20 mesh)	1	—	—	—	1	—
or						
Minute tapioca (−40 mesh)	1	—	—	—	—	—
Snow Flake Starch No. 4828 or Amaizo W-13 Stabilizer	—	—	—	4	—	—
L.M. Pectin No. 466	—	—	—	—	—	8
Sodium citrate	—	—	—	—	—	3
Citric acid	—	—	—	—	—	1
Calcium Chloride solution*	—	—	—	—	16 fl. oz.	

* Prepared from calcium chloride hydrate ($CaCl_2.2H_2O$) at 22.45 g. per litre (3.6 oz. per gal.) of water.

Blackberry and Blackberry–Apple Filling Formulae

(Approximate soluble solids content of finished product 32 per cent)

Ingredients	No. 1	
	lb.	oz.
A. Blackberry		
Fruit	80	—
Sugar	20	—
Locust bean gum	—	1½
Minute tapioca (regular)	1	—
Minute tapioca (−20 mesh)	1	—
*B. Blackberry–Apple Blend**		
Fruit—Blackberry	52	—
Apple sauce	28	—
Sugar	20	—
Locust bean gum	—	1½
Minute tapioca (regular)	—	8
Amaizo W-13 Stabilizer	—	8

* The blend is very good in flavor, color and appearance, being almost equal to the all-blackberry filling.

Black Currant–Apple Filling Formulae

(Approximate soluble solids content of finished product 42 per cent)

Ingredients	No. 1		No. 2	
	lb.	oz.	lb.	oz.
Fruit—Black Currants	35	—	35	—
Apple sauce	35	—	35	—
Sugar	30	—	30	—
Locust bean gum	—	3¼	—	1½
Snow Flake Starch No. 4828 or Amaizo W-13 Stabilizer	—	—	—	8

Note: A blend of equal parts of black currant and apple contains the least amount of black currant that may be labelled Black Currant–Apple Filling under the Regulations. A blend containing as little as 40 per cent black currant and up to 60 per cent apple sauce will also give a very high quality product but would have to be labelled Apple–Black Currant filling for marketing purposes. The same thickening agents and concentrations given in the table also would be satisfactory for this latter blend.

Blueberry and Blueberry–Apple Filling Formulae

(Approximate soluble solids content of finished product 30 to 35 per cent)

Ingredients	No. 1	
	lb.	oz.
A. Blueberry		
Fruit	55	—
Water	20	—
Sugar	25	—
Locust bean gum	—	1½
Amaizo W-13 Stabilizer or Clearjel	2	8
Citric acid	—	1
B. Blueberry–Apple Blend		
Fruit—Blueberry	55	—
Apple sauce	12	8
Water	12	8
Sugar	20	—
Locust bean gum	—	1½
Amaizo W-13 Stabilizer or Snow Flake Starch No. 4828 or Clearjel	2	8
Citric acid	—	1

Note: Twelve per cent apple sauce is about the maximum that may be used without affecting the blueberry flavor and producing an excessively granular appearance and texture.

Loganberry–Apple Filling Formulae

(Approximate soluble solids content of finished product 36 to 40 per cent)

Ingredients	No. 1		No. 2	
	lb.	oz.	lb.	oz.
Fruit—Loganberry	49	—	49	—
Apple sauce	26	—	26	—
Sugar	25	—	25	—
Locust bean gum	—	1½	—	1½
Minute tapioca (regular)	1	—	—	10¾
Minute tapioca (−20 mesh)	1	—	—	10¾
	or			
Minute tapioca (−40 mesh)	1	—	—	—
Amaizo W-13 Stabilizer or Snow Flake Starch No. 4828	—	—	—	10½

Note: The blend was about equal in color and loganberry flavor to the all-loganberry filling; the texture was generally considered superior.

Raspberry and Raspberry–Apple Filling Formulae

(Approximate soluble solids content of finished product 30 to 35 per cent)

Ingredients	No. 1		No. 2	
	lb.	oz.	lb.	oz.
A. Raspberry				
Fruit	75	—		
Sugar	25	—		
Locust bean gum	—	1½		
Amaizo W-13 Stabilizer or Snow Flake Starch No. 4828	3	—		
*B. Raspberry–Apple Blend**				
Fruit—Raspberry	48	—	60	—
Apple sauce	32	—	20	—
Sugar	20	—	20	—
Locust bean gum	—	1½	—	1½
Amaizo W-13 Stabilizer or Snow Flake Starch No. 4828	1	10	2	—

* Many tasters preferred this blend in texture, flavor and appearance to the all-raspberry filling. This is the least amount of raspberry found to yield a good product.

Strawberry Filling Formulae

(Approximate soluble solids content of finished product 32 to 36 per cent)

Ingredients	No. 1		No. 2	
	lb.	oz.	lb.	oz.
Fruit	75	—	75	—
Sugar	25	—	25	—
Locust bean gum	—	1½	—	1½
Minute tapioca (−40 mesh)	1	11	2	8
Snow Flake Starch No. 4828 or Amaizo W-13 Stabilizer	—	13	—	—
Citric acid	—	1½	—	1½

Note: The addition of 2 to 3 per cent of cranberry concentrate (36 per cent solids) improved color retention and some thought imparted a desirable flavor.

FREEZING STONE FRUITS FOR REPROCESSING

The following information will help processors who may wish to freeze stone fruits for reprocessing into canned fruit pie fillings.

Except for peaches, wash and sort the ripened fruit. There is no need to wash peaches since steam peeling removes the skins. Pit cherries and prunes; halve and pit apricots; steam-peel and slice peaches. Pack the fruit in 25-lb. containers, containing 18 lb. of fruit and 5½ lb. of 60 per cent syrup to which 0.2 per cent ascorbic acid has been added. Sour cherries can be packed with dry sugar (5 + 1); mix the fruit and sugar alternately as they enter the container.

Make sure that the upper layer of fruit is submerged in the liquid to prevent oxidative browning of surface fruit. One way to accomplish this is to place a large ball of wax paper on the surface fruit before attaching the lid of the container.

A more satisfactory method of preventing surface browning is to cover the top fruit layer with ¾ to 1 pound of granular commercial glucose such as Frodex. The granular glucose partially dissolves and forms a perfect seal preventing surface oxidation. If steps are not taken to protect this surface layer of fruit about 5 per cent will show marked browning and off-flavor.

The fruit–sugar mix should be quick frozen at temperatures below −20°F. and stored at 0°F. until used.

VACUUM TREATMENT OF APPLE TISSUE

Prepared apple slices contain enough gas in their cellular structure to cause the cells to burst during heat processing; this gas also increases corrosion of the tin plate during storage of the finished product. A rapid and efficient method of removing this gas is to subject the apple tissue to a high vacuum and to finally release the vacuum with steam. The following points are claimed as advantages:

1. The flavor of the original apple is very well retained.
2. The shape of the piece is preserved and the apple tissue is firmed.

3. The equipment for vacuum treatment of the apple tissue takes up less space than either soaking tanks or continuous hot-blanch equipment.

Note: The cycle for each vacuum chamber (Figure 10) should not take more than 15 minutes. By using multiple chambers the process becomes continuous.

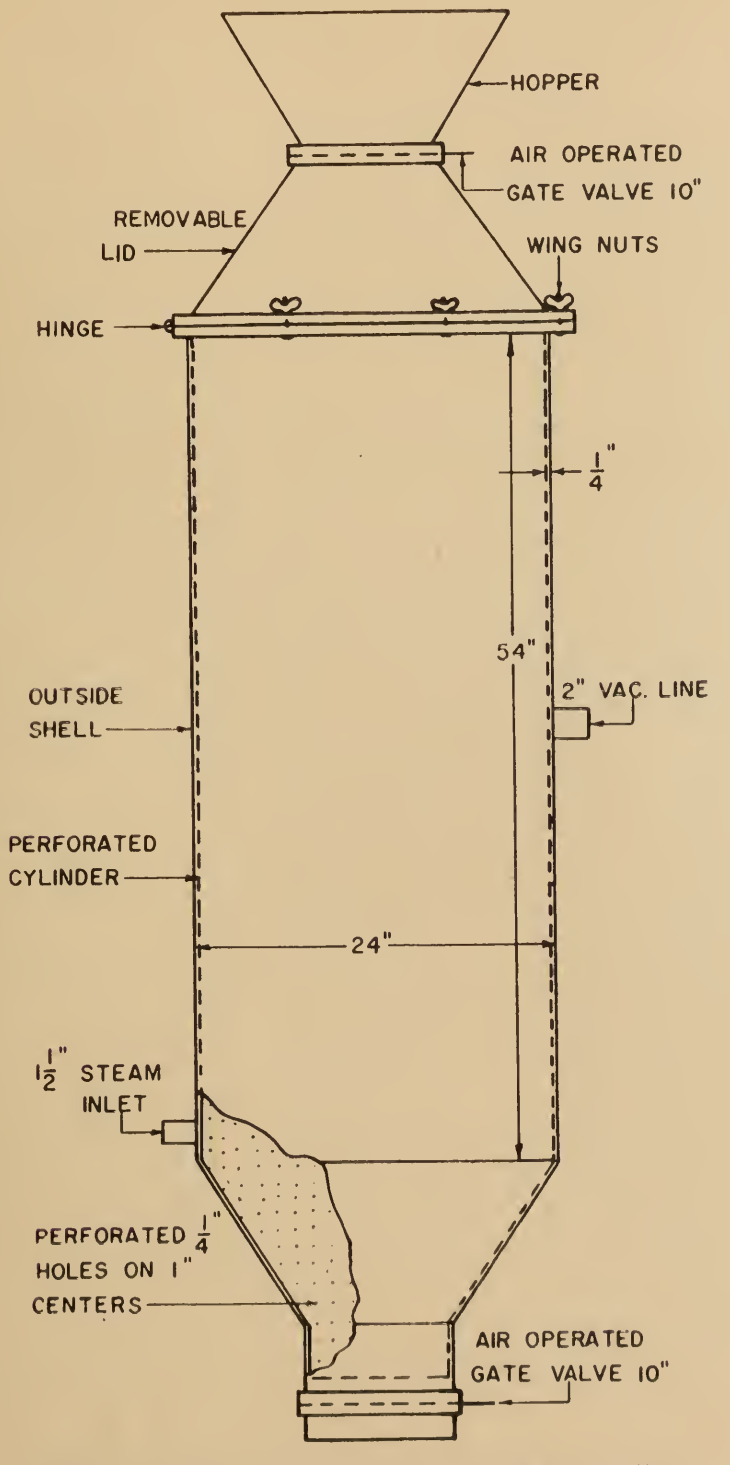

Figure 10. Vacuum chamber for treating apple slices.

Limitations as to size of vacuum chamber have not been determined. However, perforated cylinders 24½ inches in diameter and 54 inches high hold between 550 and 600 pounds of prepared apple. Chambers should be small enough to be filled in not more than 10 minutes. Even when filling is rapid, it is thought best to convey the apples in a 2 per cent salt brine while being

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prepared. The size of chamber is related to the capacity of each factory. For many plants vacuum chambers to hold perforated cylinders of 24½" × 54" could be used and extra capacity obtained by putting in more units.

Two commercial vacuum units are in use in Canada at present; one is composed of four cylinders and the other of eight cylinders. Each is equipped with mechanically operated valves for loading and unloading.

The process consists of drawing a vacuum of 27.5 inches in the vacuum chamber. With apples of correct maturity for canning this vacuum should be held for six to nine minutes and then released with steam over a two-minute period. Mature apples require as little as four minutes; hard apples may take up to 11 minutes. These times are for segments not over ⅝ inch at the thickest point. If the process is correct the segment appears translucent without any white tissue. As is usual with apple products, a blanch is required after the vacuum treatment. By continuing the steam treatment in the vacuum chamber, after the vacuum is released, the pieces can be heated to 160 to 170°F.; a large pop-off valve is necessary in case pressure develops.

For pie fillings, at least 85 per cent of the pieces should be free of any white tissue at the end of the vacuum process. If this percentage is not being obtained, lengthen the vacuum treatment.

TYPE OF EQUIPMENT

If the fruit or product contacts iron, copper or ordinary steel during processing, metallic contamination may result and affect the flavor and color. Stainless steel equipment has been found to be very satisfactory. Where suitable, aluminum, nickel and glass-lined equipment also is satisfactory.

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