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TECHNICAL BULLETIN No. 84

AUGUST, 1928

 UNITED STATES DEPARTMENT OF AGRICULTURE  
 WASHINGTON, D. C.

# PRESERVATION OF PEACHES FOR USE IN THE MANUFACTURE OF ICE CREAM

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## INTRODUCTION

Peach ice cream, made by the addition of well-ripened, crushed fruit to the mix, is one of the most popular of the fruit creams. Its manufacture is very largely confined to the months in which fresh peaches are available, and very little ice cream containing actual fruit is to be found on the market at other seasons. In the case of strawberries and a number of other fruits, large quantities are preserved by barreling and freezing (so-called cold packing) or by canning, and ice cream and other frozen products containing these fruits are obtainable almost everywhere throughout the year. Such methods of preservation for use in ice creams and like products have been applied to peaches only in a rather small way, and cream made with preserved peaches is consequently unknown to a large part of the consuming public. It is well received where it has been introduced, and it is probable that it would prove as popular as creams made with other fruits, such as strawberry and pineapple, if satisfactory supplies of preserved fruit were available to manufacturers and for home ice-cream making.

This bulletin reports the results of a study of several methods of preparing and preserving the fruit in a form suitable for use in making ice cream and of the comparative appearance, flavor, and

palatability of the creams made with these products. It represents one phase of work undertaken in an attempt to develop and expand methods of utilizing the important eastern types of peaches. No investigation of the comparative value for this purpose of the leading commercial varieties of peaches grown in the eastern peach-producing districts has heretofore been published.

Turnbow and Cruess<sup>1</sup> have reported the results of some experiments upon the use of peaches and other fruits in ice cream. The varieties of peaches employed were those most widely grown in California and included a number of clingstones that are grown primarily for canning and a few freestones that are grown both for drying and for shipping. The canning varieties of clingstones were deficient in flavor and too firm in texture. Freestones of the drying and shipping types, such as Muir, Lovell, Crawford (probably Late Crawford), and Elberta, were superior to the clingstones in texture and flavor but were somewhat lacking in the latter respect, as it was necessary to use approximately 20 per cent by weight of prepared fruit in order to obtain a cream readily recognizable as peach. Much better results were obtained with soft-fleshed, highly flavored varieties such as Carman and Strawberry. A moderately satisfactory cream, somewhat lacking in flavor, was obtained by the use of canned peaches of the solid-pack pie grade when employed in quantities of 20 per cent or more, but the addition of a small quantity of peach flavor was regarded as desirable.

### THE FLAVOR OF THE PEACH

The success of any given method of preservation of a fruit, and particularly of a fruit such as the peach, for use in making ice cream will be determined largely by the extent to which it is possible to preserve the characteristic flavor of the material. Most of the varieties of peaches now widely grown in the eastern producing territory have rather marked characteristic flavor, and it is desirable to have this individual flavor retained through the treatment given in preservation so as to be recognizable in the final product.

The characteristic flavor of the peach is due to the effect of a rather complex mixture of substances upon the organs of taste. Perception of the sugars, acid, tannins, and astringent substances permits the formation of a judgment as to the ratio which these constituents bear to one another and consequently of the palatability of the fruit, but does not enable one to distinguish between varieties of the same species or even between those of different species. Ability to distinguish between two varieties of peaches by difference in flavor is due to perception by the organs of taste and smell of the volatile constituents of the fruit, which probably differ both in nature and amount in different varieties.

The only detailed chemical study of the volatile constituents of the peach is that of Power and Chesnut.<sup>2</sup> These investigators found that the odorous constituents were very small in amount, consisting chiefly of linalyl esters of formic, acetic, valeric, and caprylic acids,

<sup>1</sup> TURNBOW, G. D., and CRUESS, W. V. INVESTIGATIONS ON THE USE OF FRUITS IN ICE CREAM AND ICES. Calif. Agr. Expt. Sta. Bul. 434, 38 pp., illus. 1927.

<sup>2</sup> POWER, F. B., and CHESNUT, V. K. THE ODOROUS CONSTITUENTS OF PEACHES. Jour. Amer. Chem. Soc. 43: 1725-1739. 1921.

with a considerable amount of acetaldehyde and traces of another unidentified aldehyde. The essential oil obtained by ether extraction of the concentrated distillate, consisting largely or wholly of acetic, formic, valeric, and caprylic esters of linalool, with traces of acetaldehyde and cadinene, had a very intense peachlike fragrance. It was excessively unstable and quickly decomposed with entire loss of fragrance upon exposure to the air. The distillate from the fruit contained no benzaldehyde and gave negative results to tests for hydrocyanic acid. The fruit employed by Power and Chesnut was of the Belle (Belle of Georgia) variety, which in point of flavor compares favorably with other leading commercial sorts, although it is deficient in this respect when compared with highly flavored varieties such as the members of the Crawford group.<sup>3</sup>

### MATERIAL AND METHODS

The fruit employed in the experiments herein reported was obtained from orchards in the immediate vicinity of Fort Valley, Ga., in the center of the Georgia peach-growing district. As the development of flavor goes on progressively through the ripening period, it was considered essential that the work be carried on in a location where supplies of fruit of any desired degree of maturity could be readily obtained. One or more of the writers were consequently stationed at Fort Valley throughout the peach-shipping season in each of the three years of the work (1925-1927). Fruit was obtained by selecting healthy, normally loaded trees of the desired varieties in a number of orchards in advance of the picking season and purchasing the entire crop of the trees from the owners. The fruit of these trees was left undisturbed until picked by the writers, who were thus enabled to procure uniform lots of fruit of any desired degree of maturity directly from the trees. The facilities and equipment of the W. L. Houser cannery were placed at the disposal of the investigators and were very largely employed in the preparation of the material.<sup>4</sup>

A rather detailed study was made of the more important commercial varieties of peaches grown in the district. These included Elberta, Belle, Carman, Hiley, J. H. Hale, and Yellow Hiley (a yellow-fleshed freestone seedling of Belle originating in the district). Some work was also done upon the minor commercial varieties Uneeda, Arp (locally known as Queen of Dixie through confusion of the two varieties), and Early Rose (a white-fleshed clingstone variety originating in Fort Valley and designated as Early Rose III by Hedrick<sup>5</sup>). In the case of Elberta, lots of material were made from fruit picked at various stages of maturity from shipping ripeness to very soft ripe. The other varieties were employed for the most part when the fruit had reached the soft-ripe condition, but a number of lots of material were made from fruit which was firm enough to be lye peeled.

<sup>3</sup> HEDRICK, U. P. THE PEACHES OF NEW YORK. 541 pp., illus. Albany. 1917. (N. Y. State Agr. Expt. Sta. Rpt. 1916, pt. 2.)

<sup>4</sup> It is a pleasure to acknowledge the writers' obligation to Mr. Houser for many courtesies and for material assistance in facilitating the work.

<sup>5</sup> HEDRICK, U. P. Op. cit., p. 352.

## PREPARATION OF THE FRUIT

The various lots of fruit were picked early in the morning in all cases, transferred immediately to the workroom, and prepared during the same day. The preparatory treatment varied with the degree of ripeness of the fruit and with the method to be employed subsequently in crushing or pulping the fruit. All lots that were sufficiently firm were lye peeled by dipping the fruit, after it had been halved and pitted, into boiling lye solution, and were then thoroughly washed in cold water. Soft-ripe fruit which was to be pulped by means of a food chopper was peeled by hand, usually after being dipped in boiling water. That which was to be pulped in a tomato-pulping machine was thoroughly washed and halved and pitted but was not peeled. In some of the earlier work the soft-ripe fruit, after washing, was run into the pulping machine without pitting.

Two methods of crushing or pulping the fruit were employed. In one, a power-driven food chopper fitted with a plate that ground the material into a rather coarse pulp was used. In the other, a power-driven tomato-pulping machine fitted with a "medium" screen (of the type used in finishing tomato catsup) was employed. The pulp so made was much more finely divided than that made with the food chopper, and only soft-ripe fruit could be satisfactorily handled in this way. By reason of the finer division of the material and the incorporation of air during the pulping, the product made with the pulping machine underwent rather rapid oxidation. The degree of the resultant browning varied with the variety of peach employed and with the promptness with which the material was handled, but was considerably greater than in check portions of the same fruit put through the food chopper.

After being crushed or pulped, the material was divided into three portions. To one of these was added 10 per cent of sugar by weight, to the second 40 per cent, and to the third none. Each of the three lots was again divided into two parts, one of which was preserved by canning, the other by freezing.

## HANDLING OF CANNED FRUIT

In the preparation of the canned material the crushed fruit was filled into No. 2½ cans, which were exhausted for 5 minutes in boiling water, sealed, and processed in an agitating cooker. Some of the cans were processed for 30 minutes and then cooled in water, while others were processed 20 minutes and cooled in air. In either case the cans were allowed to cool to room temperature before being packed into shipping cases. At the end of the season the canned material was shipped to Washington, D. C., and placed in storage in a laboratory room until used in the making of ice cream.

## HANDLING OF FROZEN FRUIT

After some preliminary experiments with other methods, the routine method adopted for handling the frozen fruit consisted in filling the crushed material into No. 10 sanitary open-top cans which were immediately sealed, packed, and transferred by automobile to the nearest available cold-storage house (at Macon, Ga.). The mate-

rial usually reached the cold-storage room within two hours after its preparation. It remained in the freezing room, which was kept at 15° F., until the following December or January, when it was removed, shipped by ordinary express to Washington, D. C., and stored at 25° until used. All material so handled was in good condition when finally opened, 7 to 9 months after packing, and several lots that were purposely held for an additional 12 months were perfectly preserved.

In the earlier years of the work, cold-storage facilities were not available at Macon, and it was necessary to ship the material to Atlanta, which involved a delay of 18 to 24 hours before the cans entered the freezing room. This material was precooled by placing the cans, immediately after they had been sealed, in a tank of ice water and allowing them to remain there for 1 to 2 hours. In some cases 0.1 per cent of benzoate of soda was added to the material. The containers employed included 1-gallon and 5-gallon slip-top cans as well as No. 10 sanitary cans, and a number of containers of each type were placed in storage at 32° F., while the remainder were kept at 15°. They were examined at the end of six months. In the lot held at 32°, the cans to which benzoate of soda or 40 per cent of sugar had been added were nearly all in good condition, while the others, regardless of size or type of container, had undergone fermentation. The material stored at 15° was in excellent condition when taken from storage, but the shipment to Washington by express resulted in the receipt of most of the slip-top cans with the lids displaced and the contents showing incipient fermentation. As it was essential to the purpose of the work that the containers used be such that they could be shipped without danger of loss, the use of slip-top cans was discontinued in favor of hermetically sealed No. 10 sanitary cans. It was clear from this experiment that storage at 32° does not satisfactorily preserve the material and that it must be actually frozen in order to produce satisfactory results.

#### PREPARATION OF ICE CREAM

Experimental lots of ice cream were made by the writers in the laboratory at Washington in each of the three years of the work, usually at some time in the spring or early summer, in which both the frozen and the canned material prepared during the previous season were used. The routine method employed in making the cream was in part determined by the necessity for making a considerable number of small lots at the same time, and was based upon a recipe in a standard textbook on cookery. It consisted in mixing 15 per cent by weight of crushed fruit with "single-thickness" whipping cream (containing 30 per cent butterfat) and adding 20 per cent by weight of sugar. The mixture was then frozen in ice cream freezers of the ordinary home type and stored in a room held at 25° F. for 24 hours prior to use. In a number of instances lots of ice cream were made with and without the addition of the amount of vanilla flavor usually added to so-called "plain cream," in order to determine whether the flavor of the fruit was affected by the presence of vanilla. In all cases a check sample of cream containing no fruit was made, to serve as a guide in determining the degree of flavor imparted by the fruit. In the summer of 1926 cream made

with canned and frozen fruit prepared during the previous season was compared with cream made with fresh fruit of the same varieties. At various times during the test, creams containing 10, 20, or 30 per cent of the preserved fruit were prepared for comparison with the standard 15 per cent mix. A commercial test of the material was also made in one year by supplying an ice cream manufacturer with both frozen and canned material which he employed in making up lots of cream, employing the usual commercial equipment and methods of handling. Comparison of these creams with those made in the laboratory by the method previously described showed entire agreement in so far as the quality of the various samples of crushed fruit was concerned.

The Elberta material employed in the tests consisted of fruit picked at three stages—shipping stage, firm ripe, and soft ripe—the first two ground in the food chopper and preserved by freezing and by canning, and the fruit in soft-ripe stage pulped by the tomato pulper and preserved by freezing and by canning. The material of each of the other varieties consisted of four lots made from soft-ripe fruit and included material ground in the food chopper and in the pulping machine, preserved by canning and by freezing. At various times, lots of cream were made with firm-ripe lye-peeled material of most of the varieties, but attention was centered in the comparative tests upon the quality of the cream made with soft-ripe fruit.

The tests of the various lots of cream made at one time involved several comparisons. These included a comparison of the products made from a number of varieties at a like stage of maturity, of the effects of the several methods of preparation and preservation, including the effects of varying quantities of sugar upon the product of the individual variety, of the relation of the stage of maturity of the fruit used to the quality of the product, and lastly, of the effects of varying proportions of fruit in the mix upon flavor and palatability of the resulting creams.

In order to obtain a considerable number of independent judgments upon each of these points, the creams made were sampled each year by practically the entire staff of the Office of Horticulture and by a number of other persons having an interest in the results of the work. The various lots of cream were designated by numbers, and each person sampling them was so questioned as to bring out his judgment upon each of the points of comparison. As was anticipated, a rather wide diversity of individual preference was expressed, and complete agreement as to relative ranking of the several varieties was not obtained. In all the conclusions herein stated, however, there was rather general agreement unless a statement to the contrary is made.

## RESULTS OF THE TESTS

### PRESERVATION OF FLAVOR

Characteristic peach flavor was plainly evident in all creams to which fruit had been added in amounts of 10 per cent or more by weight, regardless of the method of preparation and preservation which had been employed. A decided majority of those testing the

creams considered the lots having 10 per cent of fruit as being satisfactory peach creams. A minority preferred the samples which had 15 or 20 per cent of fruit, while a few individuals characterized these as having a too pronounced peach flavor. In the single test in which creams made with preserved material from the 1925 crop were compared with creams made with fresh fruit of the 1926 crop, preference for those made from the 1925 frozen material was practically unanimous. It must be said that the fruit of the 1925 crop, as a result of more favorable seasonal conditions, was somewhat superior in flavor and dessert quality to that of the 1926 crop, but the result shows very conclusively that the flavor of the preserved fruit is satisfactorily retained by the methods here described.

Power and Chesnut<sup>6</sup> found no benzaldehyde in the distillate from peaches of the Belle variety and concluded that amygdalin was restricted in its distribution to the kernels. In the present work a distinct flavor of benzaldehyde was always present in the fresh fruit of the local variety Yellow Hiley, and this persisted in the frozen or canned pulp made from that variety. Such flavor was occasionally present in pulp made from Elberta and was faintly perceptible in a few instances in that made from other varieties. It was never present in pulp made from Belle. It thus appears to be of regular occurrence in one variety and to be present occasionally in others. Its presence can not be definitely associated with split pits (to which it is sometimes attributed), with degree of ripeness, method of preparation or preservation of material, or with any particular seasonal condition.

#### RELATION OF STAGE OF MATURITY TO QUALITY

It was unanimously agreed that material made from peaches of all varieties picked at commercial picking stage was very decidedly inferior, being almost devoid of characteristic peach flavor. Flavor developed rapidly from the stage at which fruit is usually picked for shipment to distant markets onward to the time at which the fruit had become very soft, five to eight days past shipping stage. Pulp made from such fully soft-ripe fruit was always judged to be of the best flavor and the highest quality, but that made from fruit which was picked when still firm enough to be peeled with boiling lye was very nearly equal to the soft-ripe material in flavor. Development of full flavor is conditioned upon the fruit remaining on the tree; peaches picked prior to attainment of the fully ripe condition and allowed to soften in baskets at room temperature never developed the fineness and fullness of flavor characteristic of tree-ripened fruit.

#### CANNING VERSUS FREEZING AS METHODS OF PRESERVATION

The majority of the persons called upon to test the cream expressed a preference for that made with fruit preserved by freezing, stating that it had somewhat more of the natural fresh-peach flavor. A minority expressed a preference for the canned material. It was generally agreed that the differences between the two were not very marked, however, and that the canned product from thor-

<sup>6</sup> Power, F. B., and Chesnut, V. K. Op. cit.

oughly ripened fruit made an ice cream having pronounced ripe-peach flavor.

#### CRUSHING VERSUS PULPING AS METHODS OF PREPARATION

Creams made with fruit which had been rather coarsely ground in a food chopper were generally considered to have a slightly more pleasing flavor than those made from the same batch of fruit by the use of the pulping machine, but in a few instances the reverse was the case. A number of persons stated that their preference for the coarsely ground material was due to the fact that the particles of fruit were apparent to the eye and tongue, whereas the more finely divided particles made by the pulping machine were scarcely visible in the cream. The differences in flavor due to differences in stage of maturity of the fruit were very much more pronounced than those due to differences in the methods of crushing the fruit. It was apparent, however, that rather coarse crushing of the fruit, resulting in the presence of readily detected fragments of flesh throughout the cream, gives a product which will be preferred by many persons, largely upon psychological grounds.

#### EFFECT OF SUGAR ADDED AT TIME OF PREPARATION

In order to gain some evidence upon the question of whether the addition of sugar at the time the crushed fruit is prepared aids in preserving the flavor, a number of persons were asked to taste pulp preserved in the same manner with and without the addition of sugar. The samples to which 40 per cent of sugar had been added were considered by all as having the highest and fullest natural-peach flavor, and those having 20 and 10 per cent as ranking next in order, whereas the pulp having no added sugar was ranked as very much inferior in flavor. This appears to support the general belief that the addition of sugar in the process of preparation assists in preserving flavor. That this idea is erroneous was shown by the fact that when the sample preserved without sugar had 10, 20, or 40 per cent of sugar added to it, it became impossible to distinguish the product from the lots which had received like proportions of sugar when first prepared. Creams made from pulp containing 40 per cent of sugar were absolutely indistinguishable from those made with unsweetened pulp when the latter had an equal quantity of sugar added before being made into ice cream. It is therefore unnecessary to add sugar at the time of preserving the fruit, particularly if the material is to be canned. If the material is to be preserved by freezing, the addition of 40 per cent of sugar is advisable, as the presence of the sugar is a material aid in preventing fermentation while the fruit is being brought down to freezing temperature. If barrels or kegs were employed as containers, the omission of sugar would probably be disastrous, since these containers require many hours to become cooled to freezing temperature at the center.

#### PROPORTION OF FRUIT TO BE USED IN CREAM

Preliminary tests clearly established the fact that any quantity of fruit less than 10 per cent by weight was too small to yield a satisfactory cream. That containing 10 per cent was considered satis-



factory by most persons, but the flavor was progressively improved, in the opinion of a majority of the judges, by additions up to 20 per cent. It appears from this investigation that from 15 to 20 per cent should be used in order to produce a cream having full, characteristic peach flavor.

#### USE OF "BASIC FLAVOR" WITH CRUSHED PEACHES

It is an almost universal practice of ice-cream manufacturers to add a certain amount of vanilla flavor to the mix, regardless of the particular flavor that is to be given the finished product. The existence of this practice made it essential to know whether the presence of vanilla flavor would tend to accentuate or to mask the flavor of the fruit. To gain information upon this point, duplicate sets of samples of cream were made with various proportions of fruit, one set with and the other without added vanilla. The general verdict of the judges was that when 10 or 15 per cent of fruit was employed the presence of vanilla flavor in the amount commercially used in the basic mix had no effect upon the perception of peach flavor. When the amount of fruit used was reduced below 10 per cent, it was equally clear that the peach flavor was more pronounced in the cream to which no vanilla had been added. The use of vanilla in an attempt to bring out or strengthen the effect of a minimum quantity of fruit clearly produced an effect exactly opposite to that intended in this particular instance.

#### COMPARISON OF VARIETIES

There was no general agreement that any one or two varieties were markedly and consistently better than others throughout the tests. Varieties were given different ranking in different years by the group of judges, and the ranking of varieties by a given individual during the three years often showed no agreement. Belle was ranked as best more frequently than any other, and Carman next. Yellow Hiley ranked third. Elberta was considered as best by a few persons, but by a majority of the judges it was ranked with Hiley, both being considered as distinctly below Yellow Hiley in quality. Early Rose III was tested in only one year; it was ranked as best or as second only to Belle by a large majority of the judges in that year. Uneeda, Arp, and J. H. Hale were considered distinctly inferior in texture and flavor by all the judges, who differed only in regard to the relative ranking of the three varieties, none of which would appear to have promise for this purpose.

In some cases, particularly in Yellow Hiley, Carman, and Elberta, the characteristic individual flavor of the variety was carried over into the cream in such degree as to permit recognition of the particular variety employed. Belle and Early Rose III were not so recognized, although the creams made with these varieties were considered by most of the judges as having more pronounced fresh-peach flavor than those made with the other varieties. Consequently, the ranking of the various samples of cream may have been influenced in some degree by the preferences on the part of some of the judges for certain varieties.

The presence of fruit in the cream was much more evident in the case of the yellow-fleshed varieties, and the "richer" appearance of the creams made with yellow fruit was commented upon by some of the judges. It is possible that the ranking given the several varieties was influenced in a few cases by the differences in appearance of the creams.

It must be said that differences between creams made with Belle, Carman, Hiley, Early Rose III, Yellow Hiley, and Elberta were not very great when the fruit used had been allowed to become fully tree ripe, being considerably less than those between creams made with shipping-ripe and fully tree-ripened fruit of the same variety. From the results of the tests it was apparent that ice cream of acceptable quality can be made with any of the varieties named, provided that the fruit employed is allowed to become properly ripened before being prepared for use. It is somewhat doubtful whether Arp, Uneeda, and J. H. Hale could be made to yield a product of satisfactory quality.

The varieties employed in the work were necessarily restricted to those grown in some quantity in the locality in which the work was done. Study of a considerable number of varieties regarded as promising material for this purpose had to be deferred for lack of material. A limited amount of work with Slappey indicates that the characteristic flavor of this variety is well retained in the preserved material, giving an ice cream of outstanding quality. The high dessert quality and the rich, full flavor of some members of the Crawford group, as Foster, Fitzgerald, Billmeyer, and Late Crawford, make it probable that these varieties are highly promising material for use in making ice cream.

It may be noted that most of the varieties used in these investigations are of the Chinese Cling group of peaches, while the varieties mentioned above as of probable value for the purpose in question, though not tested, represent the Persian group.

#### GENERAL DISCUSSION

It can not be too strongly emphasized that a satisfactory product can not be made from inferior fruit. The use of culls or underripe or unsound fruit will result in the making of a possibly unmarketable and certainly unsatisfactory product. The fruit used must be fully ripened and of good dessert quality. Its size is immaterial, but it must be clean, free of rot and insect infestation, and must come from normal, healthy trees. It must be cleaned of dust and of adhering spray residue by very thorough washing with an efficient washing device.

The choice of a method of preparing and preserving the fruit involves consideration of a large number of factors, some of which will be briefly discussed.

The power-driven lye-peeling machines employed in the preparation of peaches for canning are highly efficient and have this very great advantage, namely, that the lye bath and the thorough washing with sprays of water following it effectively prevent the carrying over of adhering spray residue into the pulp. Such a machine can be employed only with fruit which is still rather firm, since dead-ripe fruit will go to pieces badly in the process. Soft-ripe fruit of

some varieties may be successfully peeled by being dipped into boiling water for about 30 seconds and then dipped into cold water, after which the peels may be rapidly removed by hand. A prune-dipping machine of the type employed in lye dipping prunes preparatory to drying them would appear to be well adapted to the peeling of soft-ripe peaches, as the fruit is not subjected to the severe mechanical agitation incident to passage through a peach-peeling machine. The employment of one of these methods of peeling is a necessity if the fruit is to be crushed with grinding machines of the food-chopper type. The use of such machines has the very great advantage that the product may be made of any desired degree of fineness merely by employing the proper knife or disk.

The use of a machine of the tomato or apple-butter cyclone type permits the crushing of fruit without previous peeling, provided that the previous washing has been efficient, and also permits the use of fruit too soft to be lye peeled. The employment of a screen having openings of the diameter found in the usual apple-butter or tomato screen will produce a pulp which will be considered by many people as too finely divided. Also, some difficulty will be encountered in handling firm fruit, as a result of the clogging of the screen by particles of pulp. The use of a screen having larger openings will obviate these difficulties but will introduce another, since loosened bits of skin roll together into tight cylinders which will pass through the screen in some quantities with the pulp. A combination of lye or hot-water peeling with the use of a machine of the cyclone type would avoid all of these difficulties and permit the use of a screen giving a product of any desired degree of fineness. The cyclone type of machine certainly offers the most economical method of large-scale production if the difficulties indicated can be satisfactorily overcome. The pulp made with such a machine will become somewhat brown from oxidation, but flavor is not thereby affected, and the discoloration can be held to a minimum by transferring the fruit promptly to the container. If the material is to be preserved by canning, a thorough exhausting will materially brighten the color.

Varieties differ materially in the readiness with which they can be put through the pulping machine. Carman made a very smooth, uniform pulp which flowed readily from the machine without any clogging. Belle and Elberta ranked next in this respect. J. H. Hale was notably troublesome, as it gave a granular or lumpy pulp which repeatedly clogged the machine.

The choice of a method of preservation will depend upon a number of factors. In localities having adequate facilities for refrigeration and cold storage and lying near large consuming centers the material may be preserved by freezing. If that method is used, the type of container selected will be determined by conditions. If the work can be done in a cold-storage plant or in its immediate vicinity, kegs or barrels may be used. In preserving fruit in large containers the occurrence of fermentation before the mass of pulp has become chilled to the center is the chief difficulty to be guarded against. In some of these experiments peach pulp filled into barrels at orchard temperature (90° F.) and transferred to a freezing room held at 0° to 10° required 160 hours to come to room temperature at the

center of the barrel, and the odor and flavor of the material was distinctly abnormal. To reduce the time necessary to freeze the material, the fruit used should be thoroughly chilled by being placed in the 32° room for 12 to 24 hours before it is worked up, in order that the pulp may go into the barrels at a temperature as near freezing as practicable. Forty per cent by weight of sugar should be added, and it is very important that the sugar should be very thoroughly mixed with the pulp by vigorous stirring. The barrels should be transferred to the freezing room as soon as they are filled. As there is considerable expansion during freezing, the heading up of the barrels is usually delayed until after the material has become thoroughly frozen. If these precautions are observed and strict cleanliness of plant, containers, and equipment is maintained, and the fruit is rigidly inspected and all but absolutely sound material rejected, packing in barrels can be successfully accomplished, but negligence in any of these respects is likely to have disastrous consequences.

Under some conditions it may be more desirable to use tin containers for frozen material. Turnbow and Cruess<sup>7</sup> recommend a rectangular 5-gallon enameled can having a friction seal 6 inches in diameter for the use of ice-cream manufacturers who store fruit for their own use. The investigation here reported indicates that enameled cans are not required, as corrosion does not occur. Lard cans and other friction-top containers are very satisfactory for storing material for local use, but the use of friction-top containers is inadvisable when the material is to be repeatedly handled or shipped over considerable distances. As a container for material which is to be so distributed, the No. 10 sanitary, open-top plain tin can is recommended. It can be filled and sealed by machine, which insures uniform filling. It freezes to the center fairly quickly, so that precooling prior to filling is unnecessary. The cans may be held in storage for a year or more without deteriorating in appearance or in the quality of the contents, as no marked corrosion of the cans occurs. Lastly, its size makes this can available to small as well as to large users.

Where adequate facilities for preparing and storing under refrigeration are not available, packing in cans and sterilization by heat may be employed. Any of the commercial sizes of cans up to and including No. 10 may be used. Corrosion during processing is more severe than in ordinary canning of peaches by reason of the considerable quantities of oxygen present in the pulp. Plain tin may be used, but it is advisable to use a good grade of enameled cans for pulp which is to be sterilized by heat. Corrosion is materially decreased by giving the material a thorough exhaust, 5 minutes for No. 2½ or No. 3 cans and 7 or 8 minutes for No. 10 cans. The processing time should be 40 minutes for No. 2½ or No. 3 cans and 70 minutes for No. 10 cans. They should be water cooled, and cooled to room temperature in air before they are stacked.

The employment of the usual smaller commercial sizes of tin containers has a number of advantages. By the use of a food chopper in combination with a lye-peeling machine, automatic filling and sealing machines, and a rotating cooker with water-cooling device,

<sup>7</sup> Turnbow, G. D., and Cruess, W. V. Op. cit.

large quantities of fruit can be handled with a minimum of labor. The product may be packed without the addition of sugar provided that users are instructed by label or otherwise as to the proper amounts to be added. Since canned pulp can be kept in common storage and shipped without refrigeration, it is probable that it can be produced and distributed at a cost below that of the frozen product. The use of the small container materially increases the number of potential consumers, since it makes the product available to the housewife for home ice-cream making through the same channels as other canned goods. While the frozen material retains slightly more of the distinctive peach flavor than does canned material, the use of a slightly larger quantity of the canned product eliminates this difference. Since the increase in yield of ice cream resulting from the addition of fruit will nearly or quite pay for the fruit used, it would appear possible to employ 15 to 20 per cent of fruit preserved by canning without raising the cost of production above that of chocolate or vanilla creams.

#### SUMMARY

A number of the more widely grown eastern commercial varieties of peaches have been studied comparatively with reference to their suitability for making a preserved crushed fruit or pulp for use in flavoring ice cream. Although the varieties studied differ somewhat in the degree in which the characteristic varietal flavor is preserved, an acceptable product may be made from several of them by the employment of the methods here described. Certain varieties, however, are of doubtful value for the purpose in question (see page 9). Two general methods of preservation, by freezing and by canning, have been successfully employed, and a study of the conditions under which each method may be advantageously used has been made. Preservation by freezing results in slightly better preservation of the fresh-fruit flavor, whereas preservation by canning has the advantages of a lower cost of production and distribution.

## ORGANIZATION OF THE UNITED STATES DEPARTMENT OF AGRICULTURE

July 16, 1928

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