must look like orange juice. It must be free of off-odors and off-flavors, free of dirt and foreign matter, pieces of peel, albedo and large seeds, or otherwise defective particles.

A quality control program where the buyer shares responsibility with the packer can make the job of quality control one which operates to the mutual advantage of both parties.

PREPARATION OF TANGERINE PUREE

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This work was undertaken with the idea that, if the delicious fragrance and aroma of fresh tangerines could be captured, the resulting product would be an excellent flavoring for ices, sherbets and ice cream.

On March 16th, 1944, attempts were made to can tangerine puree made by splitting the fruit and running it through a Chisolm-Ryder, screw type finisher with a screen having .027 inch perforations. The product was divided into four parts and recoverable peel oil determinations were made as follows:

TABLE I

Lot No.	
1	Fresh puree .105% recoverable peel oil.
2	Boiled but not skimmed .095% recoverable peel oil.
3	Boiled and foam skimmed off .025% recoverable peel oil.
4	Deoiled at 15" vacuum through 1" orifice for 30 seconds .017% recoverable peel oil.

Samples of each lot were heated to 195 degrees, F., and sealed in No. 2 cans. All samples were stored at room temperature and tested at monthly intervals.

Samples 1 and 2 were definitely off flavor at 60 days and were discarded.

Samples from lots 3 and 4 retained a fairly good flavor for one year but were lacking in aroma and bouquet. Lot 1, when freshly prepared, required only 7 ounces to give excellent flavor to 1 gallon of sherbet mix. Lots 3 and 4 required 30 to 35 ounces of puree, per gallon of mix, and the flavor was rather flat.

This test indicated that the amount of recoverable peel oil present in the puree was a major factor in flavoring power. On January 9th, 1945, a second attempt was made to can tangerine puree, using the same finisher and screen as in the previous test. In order to get more peel oil from the peel the finisher was set to give more pressure. The pressure was varied on different batches to control the amount of oil in the puree. Results were as follows:

TABLE II

Lot No.	
1	Fresh puree, high pressure, 1.090 recoverable peel oil.
2	Fresh puree, medium pressure .612 recoverable peel oil.
3	Fresh puree, lower pressure, .421 recoverable peel oil.
4	Fresh puree, low pressure, .117 recoverable peel oil.

Sherbet made from these samples showed that lots 1, 2 and 3 were bitter. Lot 1 was very bitter. No bitterness could be detected in lot 4.

In running lot 1 the screen burst in the finisher. A reinforced screen was made. It swelled somewhat but did not burst.

Using lot 4, table II, samples were prepared as follows:

TABLE III

Lot No.	
1	Canned at 195 degrees, F., without treatment
2	Peel oil removed in a MacKinnis still. Recoverable peel oil added back to puree before canning. Condensate discarded. Distilled water, in amount equal to condensate added to puree before canning. Canned at 195 degrees, F.
3	Peel oil removed in MacKinnis still and both recoverable peel oil and condensate added back to puree before canning.
4	Peel oil removed in MacKinnis still and condensate, only, added back to puree before canning at 195 degrees, F.

Samples were stored at room temperature and tested monthly. Lot 1 showed off flavor at 60 days and was discarded. Lot 2 retained good flavor for one year but had little bouquet and aroma. Lots 3 and 4 were off flavor in 60 days.

In pasteurizing the samples in Table III, part of each lot was canned at 190 degrees, 195 degrees and 200 degrees, F. Vacuum readings were taken as soon as the cans were

cooled to 70 degrees F. Samples were stored at room temperature and vacuum readings were again taken at the end of one year. Since there was considerable difference in the same lot, especially in lots 3 and 4, 20 cans of each lot were used in order to get a good average. Table IV shows the average vacuum after one year:

TABLE IV.

Lot No.	Vacuum at start, 70°	Vacuum after 12 mos. 70°
1 190	degrees, 17 inches	11 inches
1 200	" 18 "	11.5 "
2 190	" 17 "	16.5 "
2 200	" 18 "	17.0 "
3 190	" 17 "	3.5 "
3 200	" 18 "	4.0 "
4 190	" 17 "	3.0 "
4 200	" 18 "	3.5 "

Lot 1 showed little etching of the cans, lot 2 showed no etching at all and lots 3 and 4 showed very bad etching. A few cans of lots 3 and 4 perforated before the year was ended. Lot 1, at both 190 and 200 degrees, showed variation of from 9 to 14 inches of vacuum at the end of the year.

Lot 2, both 190 and 200 degrees, showed variation of only 1 inch at the end of the year.

Lot 3, at 190 degrees, varied at the end of the year from 9 inches of vacuum to 4 inches of pressure. Lot 3, 200 degrees, varied from a vacuum of 8 inches to pressure of 3 inches.

Lot 4, at both 190 and 200 degrees, F., showed the same variation, from vacuum of 9 inches to pressure of 4 inches. Something in the condensate caused off flavor in lots 3 and 4 and caused etching of cans and loss of vacuum.

The data indicate that there was a change in the composition of the deleterious ingredients when they were removed from the puree and then put back into it. They were much more active when removed from the puree and then put back than when they were left in without removal.

In May of 1946 samples were prepared with high, medium and low pressure on the finisher. The results were much the same as shown in Table II. The low pressure samples showed recoverable peel oil of .104%. Some of these low pressure samples were heat sterilized and canned. Other samples in the low pressure lot were sealed raw and stored at 35 degrees, F., and at -10 degrees, F. All samples were tested at monthly intervals. The heat sterilized samples, stored at room temperature, were off flavor at the end of thirty days.

The samples sealed raw and held at 35 degrees, F., held their flavor for two months but, at the end of the third month had a poor flavor and a high mold count.

Samples of raw puree held at -10 degrees, F., showed no deterioration or loss of flavor at the end of one year. Some of these samples were held for two years and still showed no change that could be detected by taste panels.

On November 20th, 1946, samples of tangerine puree were put up under low pressure from fruit that appeared to be mature and had passed the State maturity test. Even though extracted under low pressure these samples were bitter when first processed and had low flavoring power. Only *-10 degree* storage was used on these samples.

Since the samples put up late in the spring, under the same conditions, had high flavoring power and were not bitter, it was decided to put up samples each month to see what changes could be noted as the season advanced.

On December 15th the samples processed were bitter but not as bitter as those put up in November.

Samples put up on January 12th had no bitterness but were rather low in flavoring power, requiring 9 ounces per gallon of mix to give good flavor. Samples were processed each month through July, when the last of the late bloom tangerines were available. Flavoring power and aroma increased each month to the end of the test, even though the fruit was half dry at the end.

During the winter and spring of 1948-49 a number of tests were run to determine the best screen size. The extractor used was a pulper manufactured by Food Machinery Corporation which removed the juice and pulp with very low pressure. Screens with perforations of .020, .027, .042 and .062 inches were used. In all cases the mix was 3 parts of fruit to one part of sugar. Table V shows the yield of finished puree per 90 pound box of fruit:

TABLE V

Screen	Yield, per box of fruit.
.020	29 pounds
.027	38 "
.042	48 "
.062	59 "

Screen size .062 was ruled out because it allowed the seed pips to go through and taste panels did not like to see these undeveloped seed in the sherbet.

The other three screen sizes gave excellent flavor as judged by the taste panels. No difference could be detected between the three in sherbets and ices but the .042 product could be seen in ice cream while .020 and .027 could not. Some ice cream manufacturers like to have these small pieces of fruit pulp in their products to show the consumer that the flavor is not synthetic.

Screen sizes .020 and .027 gave rather slow production in the pulper where pressure could not be applied. Size .042 gave comparatively rapid production. The average time required to process a 90 pound box of fruit was as follows:

TABLE VI

Screen	Minutes, per box of fruit
.020	17
.027	13
.042	2

Tangerine puree extracted in a paddle finisher, or pulper, seems to have a better flavor than when prepared in a screw type finisher. This may be due to the fact that there is always the tendency to get more yield by putting more pressure on the screw type finisher. The pulper avoids this temptation since high pressure cannot be applied.

Commercial scale consumer acceptance tests were started in 1948. Tangerine puree can be made with or without sugar but it is customary to furnish the ice cream manufacturer with a product that meets his regular formulation. If he uses three parts of fruit to one part of sugar he wants all of his fruits to have this ratio. This was the ratio used in all tests made in 1948.

The manufacturers cooperating in these tests were:

Cone's Dairy, Plant City, Fla.
Schneider Ice Cream Co., Eustis, Fla.
Pipkin's Dairy, Lakeland, Fla.

The puree was prepared by splitting the whole tangerines, extracting the juice and pulp in a pulper, mixing with sugar and freezing at -17 degrees, F. Storage was at -10 degrees, F.

Tangerine sherbet was put on sale by these three dairies without advertising or promotion of any kind. The first tests were in the school lunch rooms where it was an immediate success. Sales through all outlets increased steadily until, in 1950, reports indicated that tangerine outsold all other sherbets combined. After three years of testing various mixes, shades of color, sweetness and other factors that influence repeat sales the product was released for commercial production during the winter of 1951-52. The formula that got the best acceptance was substantially the same as that worked out by Mr. Owen Bissett, at the USDA Citrus Products Laboratory in Winter Haven. It is as follows:

Tangerine puree,	8 oz.
Gelatin	½ "
Milk solids, serum or fat,	3%
Sucrose,	2 lbs.
Dextrose	12 oz.
Citric acid, 50% solution,	1 "
Water to make one gallon	
Color as desired.	

A little more or a little less puree may be needed, depending on the time of the year when the puree is made.

Color is very important. During consumer acceptance tests of sherbets with, and without, color were offered to school children so that they had free choice. Acceptance was 11 to 1 in favor of the well colored sherbet.

By increasing the sugar content to 2 parts of sugar to 1 part of fruit an excellent ice cream topping for sundaes was made. This product also gave a fine flavor to malted milks, milk shakes and other fountain drinks.

Tangerine puree containing 2 parts of sugar to 1 part of fruit was tried by Butter Crust Bakeries, Inc., of Lakeland, as a cake filling. This gave excellent flavor to the cakes and will probably be one of the largest uses for this puree.

Hardin's Bakery, at Tuscaloosa, Alabama, tried tangerine puree as a cake flavoring material before baking. This was not successful because all tangerine flavor was lost in baking. Various combinations of dextrose and sucrose were tried during consumer acceptance tests. Dextrose gave good results in all

proportions up to 50% of the total sugar used. When more than 50% of dextrose was used the dextrose crystalized out on freezing and gave a "bloom" to the puree that looked like mold.

Conclusions

From the data presented here it is concluded that, under the conditions of these tests, heat sterilized canned tangerine puree does not hold its flavor long enough to be practical as a flavoring material for ices, sherbets and ice cream. It is further concluded that, under the conditions of these tests, frozen tangerine puree holds its flavor without appreciable loss for at least two years and makes an excellent flavoring material for ices, puree, ice cream, cake filling and fountain drinks.

From the fact that, during consumer acceptance tests, the sale of frozen tangerine puree approximately double each year for three years, without advertising or promotion, at each of three outlets, it is concluded that frozen tangerine puree is a product that has met with good consumer acceptance.

Acknowledgment

During the time that some of these tests were being run Mr. Owen W. Bissett, at the USDA Citrus Products Laboratory in Winter Haven, was also working on frozen tangerine puree, along with other citrus purees. Neither of us knew of the work being done by the other. Mr. Bissett called at my laboratory one day and mentioned the work that he was doing on frozen citrus purees. I told him of my work and was glad to adopt several helpful suggestions made by Mr. Bissett.

CLARIFICATION IN HEAT - TREATED PINEAPPLE ORANGE CONCENTRATES[1]

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The stabilization of orange concentrate by heat-treatment during processing prior to freezing has been a subject of considerable study during the past several years in both commercial plants and research laboratories. The two principal reasons for heat treatment, either of the raw juice prior to concentration or of the concentrate during or after evaporation, are (a) the partial or complete inactivation of pectinesterase, the enzyme which may cause clarification and gelation, and (b) the destruction of acid-tolerant microorganisms that may cause spoilage during processing. In the commercial production of hot-pack concentrate for storage at refrigerated temperatures of 32° to 45°F., the practice has been to use sufficient heat treatment to provide complete enzyme inactivation and a commercially sterile product.

This report covers the results obtained from two investigations during the 1950-51 season on heat treatment of Pineapple orange juices and concentrates. The first study was concerned with the effect of the heat treatment of orange juice before concentration to 42°-Brix on pectinesterase activity, clarification and gelation during storage, and the destruction of microorganisms. The second investigation was undertaken to determine the temperature necessary for both the initial heat treatment of the orange juice and the final treatment of the concentrate in order that the hot-packed product could be stored at 32°F. without appreciable deterioration of quality. Because of the effect of heat treatment on the flavor of the product, it is desirable that the minimum amount of heat treatment necessary for obtaining the desired product stability be used.

Experimental Procedure

Heat Treatment of Juices prior to Concentration. — Pineapple oranges were thoroughly washed, the juice extracted in a Rotary press and finished in a Food Machinery (Model 35) finisher equipped with a 0.020 inch perforated screen. The pulp content of different batches of raw juices used was adjusted to

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[2] Florida Citrus Commission.

[3] Florida Citrus Experiment Station.