The earliest development in the art of food preservation was undoubtedly inspired by the need of extending food supplies beyond normal seasonal limits. Following early successes a second objective was introduced: that of improving the quality of the product. Food processors of today are keenly interested in maintaining the highest quality possible. It has been only in fairly recent years that the search for better processing methods to obtain high-quality products has turned to freezing and frozen storage. It is true that as early as 1905 small fruits packed in sugar syrups were frozen in the eastern United States and that in 1909 "cold pack" berries were processed in the Pacific Northwest. It later became apparent that many users would prefer a mashed or pureed material to whole fruit. Consequently, in 1931, the Bureau of Agricultural and Industrial Chemistry instituted investigations at its laboratory in Los Angeles, California which resulted in the development of a whole new series of fruit and berry purees suited to frozen storage methods.

Citrus fruit purees were not originally included in this program as it had been thought that such products would be too strong in flavor and might develop "terpeney" off flavors in storage. In 1947, however, citrus puree investigations were inaugurated at the Fruit and Vegetable Chemistry Laboratory, Los Angeles, California, under the direction of Dr. E. A. Beavens. Preliminary work was done near the end of the Valencia orange season and the results were so promising that the successful commercial production began the following year.

As a result of the wide interest in and the active market demand for citrus purees, name-

Other varieties of citrus fruits were tested including tangerine, Tardia lime, Persian lime, and Key lime. It is anticipated that additional orange varieties will be used during their respective seasons in the coming fruit year.

**Methods of Processing**

The method of processing the fruit was essentially that developed at the Los Angeles laboratory. It consisted of thoroughly washing sound, mature fruit, preferably with a good detergent and rinsing with cool or cold water, followed by halving or quartering the fruit, depending on size, and passing through a laboratory model Chisholm Ryder Sep-ro-siv* fitted with a screen of 0.27-inch openings. This machine operates on the principle of a tapered screw within a conical screen with the juice, peel oil, and some pulp being forced through the screen while the seeds, rag, and remainder of the rind are ejected at the small end of the screw flight. Openings larger than 0.27-inch allow the passage of particles of pulp of such size as to be objectionable in the end product. The puree obtained from the Sep-ro-siv was fortified with sucrose (1 part sucrose to 5 parts puree by weight) and after thorough mixing was canned and quickly frozen.

Purees stored at 0°F. for eight months show no apparent change in color, flavor or vitamin C content. Dr. Beavens, who has studied such products over longer periods, finds that they may be kept in good condition for more than a year. The puree may be defrosted, a
portion used, and the remainder refrozen without injury to color or flavor, provided it is not exposed to the air for long periods nor the temperature of the product allowed to rise too high.

The importance of using good clean fruit is self-evident, as there is no pasteurization or other biological control during processing. By the same token it is essential that once started, the preparation be carried to completion as rapidly as possible.

**DISCUSSION**

**Orange Purees**

The yield of puree from Florida Valencia oranges has been found to be in the range of 55 to 60 percent by weight of the whole fruit, and contained about 18 percent suspended solids, 1 percent citric acid and 1 percent peel oil. This percentage of oil is comparable with that contained in commercial California purees. The values may be expected to vary with varieties and seasons.

Purees prepared at the Citrus Products Station have been evaluated through the medium of milk sherbets. An orange sherbet containing 6 to 7 ounces of sweetened puree per finished gallon was judged superior to any locally available orange sherbets, including that of a nationally advertised brand. It was also judged superior to an experimental orange sherbet containing 48 ounces of freshly extracted juice instead of puree, a product judged superior to any commercial sherbet. It appears that peel oil is a major flavor factor in citrus purees since a small proportion of orange puree of high oil content produced a milk sherbet judged superior to a similar sherbet containing a large proportion of freshly extracted juice of low oil content. It is thought that one of the reasons for the high quality of the products prepared from citrus purees may be the high percentage of oxygenated constituents in the emulsified peel oil it contains. While the oxygenated constituents have not been determined in this product, it is well known that the usual methods of manufacturing peel oil results in a partial loss of them because of their partial solubility in water. These constituents are largely responsible for the characteristic flavors and aromas of citrus peel oils. In the manufacture of puree there is no chance for them to escape.

**Sherbet Formula**

The sherbet formula used with the orange and other citrus purees was as follows:

- Gelatin: 0.5 ounces dissolved in 2 ounces boiling water
- Milk (evaporated): 2.0 pounds
- Sucrose: 12 ounces
- Dextrose: 5 ounces
- Orange puree: 5 ounces
- Citric acid (50% Soln.): Approx. 1 ounce to give characteristic flavor
- Certified food coloring to give characteristic color
- Water to make one gallon

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The above formula represents about .75 percent butter fat and 1.2 percent serum milk solids. There seems to be quite some variance in the butter fat and serum solids concentration used by commercial sherbet manufacturers but in general the values run in the order of 2.0 to 2.5 percent of each. A supply of a commercial sherbet base containing 2 percent butter fat and 3 percent serum solids was obtained and used in the preparation of sherbets using varying proportions of orange puree. It was found that the higher milk solids base masked the delicate orange flavor. Increased concentration of the puree did not overcome the masking of flavor but only raised the peel oil content of the product to the point that it was quite objectionable.

**Tangerine Purees**

A tangerine puree was prepared from overripe fruits which were obtained after the close of the normal processing season (1949) for this fruit. The sherbet prepared from this puree was judged excellent when fresh, having the flavor of prime quality tangerines, but after a few days the sherbet had developed an off flavor much like that of stale fruit. Later a second portion of the puree was used in preparing an identical sherbet with the same result. Thus it is indicated that the flavor change takes place after preparation of the sherbet and not in the frozen puree. Further work with this fruit is necessarily postponed until next season's crop is available.

**Lime Purees**

Investigation of lime purees was undertaken in the late spring of 1949, again after the
close of the normal season for this fruit. The only variety available was the “Tardia” which, like the tangerine, was over-ripe; and the fruits, though found to be normally acid, had lost all their characteristic lime odor and flavor. The sherbet prepared from the puree was quite palatable and tart but did not have the characteristic lime flavor. Later, when the first limes of the current season began to move to market, some of the “Persian” variety was processed. In the resulting sherbet it was found that a bitter characteristic present in the rind of the fruit had been incorporated in the product making it unpalatable. Sometime later more mature Persian limes were obtained and processed to determine whether the degree of maturity influenced the presence of the bitter characteristic. Experiments to date have shown no abatement of this objectionable bitterness as the season progressed.

Since the bitter flavor was obtained with green Persian limes, a puree of ripe Key limes was made to see whether these gave the same result. The sherbet exhibited the same bitter characteristic previously encountered though perhaps to not quite such an extent as that of the Persian variety.

It is planned that investigations will continue on both these lime varieties and on others as they become available during the coming fruit season. Since lime sherbet is one of the most popular sherbets, it is thought that lime puree would offer an excellent opportunity if the right combination can be found.

**Summary**

Citrus purees have been prepared from a number of varieties of Florida fruits by the method developed at the Fruit and Vegetable Chemistry Laboratory in Los Angeles, California. The purees were evaluated through the medium of milk sherbets. Florida Valencia orange puree is recommended as an excellent product for use in preparing orange sherbets of superior flavor appeal. It is also suggested that a lower total milk solids sherbet mixture be used than that of present commercial practice in order to obtain the true flavor characteristic of the fruit.

Tangerine and lime puree cannot be recommended at this time. Lemon and other orange varieties will be investigated during the coming season.

**REFERENCES**

1. E. A. Beavens, New Frozen Purees from Citrus Fruits. AIC-238, August 1949

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**THE VITAMIN P CONTENT OF FROZEN ORANGE CONCENTRATE**

Boris Sokoloff and James Redd

*Research Department, Citrus School*  
*Florida Southern College*  
*Lakeland, Florida*

From time immemorial the therapeutic properties of citrus fruits have been recognized by the medical profession. In China, where citrus trees were cultivated for thousands of years before they were brought to Europe, the value of oranges for health has long been common knowledge. In old Chinese manuscripts and medical treatises of a thousand years ago, one may find here and there an indication that oranges should be used in bleeding and exhaustion. One may also read about the use of citron in diseases of the joints, so common in ancient Greece, in the writings of philosophers and physicians of that epoch.

Although scurvy was known for centuries and described by Euricius Cordus in 1534, the famous British surgeon John Lind was the first to explain, as early as in 1757, the symptoms of scurvy and to demonstrate that the bleeding characteristics of this disease can be arrested promptly by the generous use of citrus juice.