

Citrus Section

FROZEN TANGERINE CONCENTRATE¹

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In considering the utilization of tangerines for the manufacture of frozen tangerine concentrate, emphasis should be put upon the following factors: a good quality concentrate can be made and the quality maintained by frozen storage, the supply of tangerines is actually limited from the processors' and consumers' viewpoints, and handling and processing costs for production of tangerine concentrate will be greater than similar costs for orange concentrate. With these factors in mind this report will consider the supply and demand situation relative to tangerines, some of the problems that confront the processor in the production of a good quality tangerine concentrate, and some suggestions that may help to bring about complete utilization of the Florida tangerine crop. The possibilities of tangerine concentrate in providing an outlet for this fruit were previously discussed by the senior author at the Sixth Annual Gulf Citrus Growers Institute, Brooksville, in April 1951, and also at the Eighteenth Annual Citrus Growers Institute, Camp McQuarrie, Lake County, in Au-

gust 1951. This report provides additional current information.

Tangerine Supply and Demand. During the past four fruit seasons, out of a total crop of tangerines of from four and one-half to five million boxes, approximately three and one-half million boxes were sold either as fresh fruit interstate or as fresh fruit in Florida and approximately one-half to one and one-half million boxes were available for processing either as single-strength canned juice, tangerine concentrate, or other processed products. The total disposition of Florida oranges, grapefruit, and tangerines, as well as the utilization of these citrus fruits by canning and concentrating plants, is shown in Table 1 for the past four seasons. Over 53% of the citrus fruit used during and since the 1949-50 season went to the commercial processing plants with the utilization of oranges, grapefruit, and tangerines showing ranges of 59 to 63%, 41 to 56%, and 16 to 32%, respectively. A comparison of the quantity of tangerines sold as fresh fruit with that used by commercial processors is presented in Table 2, and also a further breakdown showing the boxes of tangerines used for both canned juices and frozen concentrate, which definitely was produced in greater volume during the 1952-53 season than during the 1951-52 season.

Considering the quantity of tangerines available for processing from the viewpoint of both

¹ Cooperative publication of the Florida Citrus Experiment Station and Florida Citrus Commission.

Table 1
Disposition of Florida oranges, grapefruit, and tangerines^b

Season	Oranges			Grapefruit			Tangerines			Totals		
	Total Boxes	Cannery Commercial Boxes	%									
1949-50	58,553,679	34,657,323	59	24,206,061	13,486,200	56	5,000,009	1,594,920	32	87,759,749	49,738,443	57
1950-51	67,302,284	41,857,889	62	33,224,132	17,813,786	54	4,800,000	1,354,572	28	105,326,416	61,026,257	58
1951-52	78,807,067	47,450,510	60	32,791,071	13,593,001	41	4,084,622	657,136	16	115,682,760	61,700,647	53
1952-53	72,855,267	45,838,898	63	32,727,318	15,167,188	46	4,900,000	1,064,134	22	110,482,585	62,070,220	56

^b Citrus and Vegetable Inspection Division. Annual reports for 1949-50, 1950-51, 1951-52 and 1952-53 seasons. In terms of 1-3/5 bushel boxes. Florida Department of Agriculture, Winter Haven, Florida.

Table 2
Disposition of tangerines^c

Season	Fresh fruit ^d Boxes	Commercial canmery Boxes	Used for canned juices Boxes	Used for frozen concentrate Boxes
1949-50	3,405,039	1,594,920	1,485,366	-----
1950-51	3,445,428	1,354,572	973,753	-----
1951-52	3,427,486	657,136	339,967	298,440
1952-53	3,835,866	1,064,134	567,594	491,885

^c Citrus and Vegetable Inspection Division. Annual reports for 1949-50, 1950-51, 1951-52 and 1952-53 seasons. In terms of 1-3/5 bushel boxes. Florida Department of Agriculture, Winter Haven, Fla.

^d Total of certified fresh fruit shipments, express shipments, and non-commercial intrastate use.

the manufacturer of concentrate and the potential consumer consumption, the one-half to one and one-half million boxes of tangerines available is actually a limited supply and is extremely small in comparison with the quantity of oranges that is now utilized yearly for the production of frozen orange concentrate. During the 1952-53 season 46,553,695 gallons of frozen orange concentrate were produced, as compared to the production of 551,397 gallons of tangerine concentrate (3).

It is interesting to note the quantity of tangerine concentrate that would be available for distribution to consumers if a million boxes of tangerines were processed. Information in Table 3 indicates an average yield of 1.15 gal-

Table 3
Frozen tangerine concentrate production^e

Season	Tangerines used Boxes	Concentrate produced Gallons	Concentrate yield Gal./box	Juice yield ^f Gal./box
1951-52	298,440	340,161	1.17	4.64
1952-53	491,885	551,397	1.12	4.45

^e Citrus and Vegetable Inspection Division. Annual reports for 1951-52, and 1952-53 seasons. In terms of 1-3/5 bushel boxes. Florida Department of Agriculture, Winter Haven, Fla.

^f Calculation based on 42°Brix concentrate and 12°Brix juice and assuming no addition of sugar.

lons of concentrate per box of fruit. On this basis a million boxes of tangerines would yield 1,150,000 gallons of concentrate (1,022,200 cases of 24 six-oz. cans). The average weekly national consumer purchases of frozen concentrated orange juice, as estimated by Market Research Corporation of America for six months, April to September inclusive, during 1953 was about 1,076,000 gallons per week. If consumer consumption of tangerine concen-

trate would reach 5% of the present rate of consumption of orange concentrate, then the 1,150,000 gallons of tangerine concentrate produced from a million boxes of fruit would be consumed within approximately 21 weeks. To process one million boxes of tangerines into 1,150,000 gallons of concentrate, a plant with an evaporation capacity of 20,000 pounds of water per hour would have to operate efficiently and continuously for approximately 60 days. Thus from these calculated figures it is evident that the supply of tangerines is actually quite limited from the standpoint of both the processor and the consumer.

Problems in Processing Tangerine Concentrate. A frozen concentrated tangerine juice of good quality can be made provided fruit of good quality is carefully handled and properly processed. Experimental packs of frozen tangerine concentrate have been processed in the pilot plant at the Station and the characteristics of the concentrates were previously discussed (5). Results indicated that frozen tangerine concentrates of good quality can be made. Tangerines are definitely more difficult to process into frozen concentrate than oranges chiefly because of the size, shape, and fragility of the fruit. To overcome some of the difficulties encountered, greater handling and processing costs are incurred which make production costs for tangerine concentrate greater than similar costs for orange concentrate. The major problems arise from the time the fruit is picked until after the juice is extracted and screened prior to concentration in high-vacuum, low-temperature evaporators such as described by Atkins, Wenzel, Fehlberg, and Slater (1). The concentration of the juice and its subsequent freezing and storage pose no special problems.

Fully mature fruit should be used if a good flavored concentrate is desired and therefore the fruit should not be harvested until January or February. Early in the season the addition of sugar to the juice, although not recommended, is possible if the Brix/acid ratio is too low for consumer acceptance. Late in the season the fruit becomes dry and puffy, which results in a decrease in the juice yield. Since a large volume of tangerines is shipped for the Thanksgiving and Christmas trade, if the cost were not prohibitive, such fruit could be spot-picked for quality as needed and the excess fruit allowed to remain on the tree to be harvested later for processing into concentrate.

In harvesting, tangerines should be clipped and not pulled since pulling often results in plugging the fruit. Plugged fruit becomes contaminated not only with dirt but also with microorganisms that may cause spoilage of the fruit prior to or during processing; also plugged fruit becomes contaminated with detergents used for washing fruit at the processing plant.

In hauling tangerines from the grove to the processing plant they should be handled carefully. Field boxes can be used. When hauled in bulk tangerines cannot be piled as high in trucks as oranges because they become mashed and damaged quite easily. The use of baffles in trucks might make it possible to haul larger quantities of fruit with a minimum amount of damage. Utilization of damaged or spoiled fruit by the processing plant results in products of poor quality and therefore such fruit should not be used.

Tangerines tend to deteriorate and spoil faster than oranges and therefore should be used as rapidly as possible after arrival at the processing plant if losses are to be prevented. The fruit cannot be stored in available fruit bins and therefore storage ties up hauling equipment. Also since the fruit is not stored in fruit bins, it is practically impossible to blend the fruit to obtain a definite Brix/acid ratio in the juice.

When processing equipment designed and built for handling oranges is used to handle tangerines, various problems arise because of the difference in the size and shape of these fruits. Difficulties are encountered during the washing, conveying, sizing, and extraction operations and consequently losses of fruit, juice, and production time result. For production of a good product excessive amounts of peel extractives in the finished concentrate should be avoided. Therefore, if large particles of peel get into the juice during extraction they should be removed from the juice by screening before it enters the juice finisher for final screening. Thus in some plants it may be necessary to introduce another operation into the processing procedure. Also the small size of the fruit and lower juice yield per box creates a problem of having sufficient extraction equipment available for obtaining the large volume of juice required by the evaporating equipment. After the juice has been extracted and screened, processing of tangerine concentrate is carried out using the same procedures and equipment that are used for the

manufacture of orange concentrate without encountering other difficulties. The concentrated tangerine juice, if properly and carefully manufactured, will be of good quality which can be maintained by frozen storage.

The yield of juice or concentrate from a box of tangerines is smaller than that obtained from a box of oranges. The quantity of concentrate that can be made from a box of fruit depends upon both the juice yield and the soluble solids content ($^{\circ}$ Brix) of the juice (Table 4). It is evident that if the cost of tan-

Table 4
Comparison of number of boxes of oranges and tangerines to yield 100 gallons of 42 $^{\circ}$ Brix concentrate

Brix of juice	Oranges	Tangerines
	1.43 gal./box	1.12 gal./box
10	85	108
11	77	98
12	70	89
13	64	82

gerines and oranges is the same, then the total cost for the production of tangerine concentrate will be greater than that for orange concentrate because of the lower yield of tangerine concentrate obtained from each box of fruit. Also other factors, such as the need for more grading and the impossibility of obtaining full plant capacity, while fixed costs and other labor costs are about the same, result in total factory costs for processing tangerines into concentrate that are considerably greater than those for processing oranges.

Suggestions for Complete Utilization of Tangerine Crop. The following suggestions are offered as steps to be considered that might help to bring about complete utilization of the tangerine crop. As much of the crop as possible should be sold as fresh fruit after being harvested as needed and such fruit should be picked carefully from the standpoint of quality. Fruit to be processed into frozen concentrate should not be harvested until January or February. Since from the processors' standpoint the crop is limited, it would perhaps be better if two or three plants could process all of the tangerines available into concentrate. Such plants should be located as close as possible to the areas in which most of the tangerines are produced to eliminate long distance

hauling. Also these plants should be properly equipped so that the fruit may be handled and processed efficiently. Processing of all the fruit available within one or two months is also desirable.

Since the supply of finished concentrate would also be limited from the consumers' point of view, perhaps it would be wise not to attempt national distribution but to limit its sale to a number of large markets during a certain time of the year, such as the summer months. It has been pointed out that tangerine concentrate may be more expensive to produce than orange concentrate because of extra costs incurred during harvesting and hauling, lower yield per box, losses of fruit before and during processing on account of spoilage and difficulties in handling, and greater factory costs. To take care of these increased costs the tangerine concentrate could be sold to the consumer as a specialty item at a premium price and thereby make possible a just and reasonable profit to both the grower and the processor. Other tangerine products which are outlets for the fruit are a tangerine base for sherbet as described by Bissett (2) and Singleton(4), canned tangerine juice and blended juice, and tangerine popsicles.

Some attempt to put these suggestions into operation could be made by the coordinated effort and action of growers and processors working with such agencies as the Florida Tangerine Cooperative, Florida Citrus Commission, and Florida Citrus Mutual. The solution of the problem of utilizing not only all of the tangerines, but also the increasingly large Florida crop of oranges and grapefruit, will depend on the efforts and cooperation of growers, processors, and all other persons who are interested in the welfare of the Florida citrus industry.

LITERATURE CITED

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THE NECESSITY FOR QUALITY FRUIT IN THE TERMINAL MARKETS AND ITS ADVANTAGES TO THE DEALER SERVICE DEPARTMENT AND THE FLORIDA GROWER

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You may be surprised to hear that many fruits fall into what is considered the luxury class. Furthermore, that a large share of them are bought on eye appeal. Let's not attempt at this time to go into the question of whether or not citrus fruits should be considered luxury items. However, I firmly believe, and I hope you agree, that attractiveness is always important. When we speak of attractiveness we, of course, mean quality. And when we say citrus quality, we also mean quality internal and external. Our citrus fruits are not in a class with the Atlantic City bathing

beauties who compete but once a year. We're contending for honors practically every day in the season. We would indeed be short-sighted if we did not realize that fact and its importance. Today with the competition increasing on fresh citrus fruits in terminal markets, it becomes apparent immediately that quality fruit is the only kind that can be expected to hold its own. Likewise, it is the only kind which will prove profitable to both shipper and grower.

There is no doubt that a substantial percentage of the consuming public insists upon fresh fruit. A certain percentage always will. What that percentage will be depends on the growers and shippers of Florida. I'm certain every one here would prefer to avoid a situation in which fresh fruits would play an insignificant part in our great industry. I am also