

this vitamin are retained in the juice during processing and storage.

An article, "Papaya Products," by J. L. Heid and A. L. Curl (4), based on previous work, gives considerable information on the preparation of a number of papaya products.

A paper entitled "Comparison of Methods for the Determination of Moisture in Dehydrated Vegetables" by A. L. Curl (3) appeared during the year. It presents comparative information on vacuum oven, benzene distillation, and toluene methods for determining moisture.

An article entitled "The Citrus Canning Waste Disposal Problem in Florida," by R. S. Ingols (5) gives a general review of the waste disposal situation and suggests solutions to some of the problems encountered.

It is believed that the U. S. Citrus Products Station at Winter Haven, Florida, has made substantial contributions to the knowledge of citrus products during the past year and it is hoped that even more valuable information will be obtained in the future.

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DEHYDRATED ORANGE JUICE

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Recently a process for dehydrating or removing the water from orange juice has been developed and this process will be exploited by Florida Foods, Inc. In evaluating the possibility of success of orange juice dehydration by Florida Foods, Inc., it might be well to examine the skills of the parent company, namely the National Research Corporation.

This company was organized in 1940 for the purpose of research in all branches of industry, but more particularly in those fields where high vacuum could profitably be employed in the solution of problems. Almost immediately after the company was formed it became engaged in war work on its own account and was presented with many technical

problems by America's largest manufacturers. They were instrumental in perfecting the high vacuum equipment by which penicillin is manufactured and approximately 95% of the world's penicillin today is made in part by machinery and technique worked out by the National Research Corporation. In addition, they have spent considerable time on other food industry problems, on problems of the petroleum industry, and a considerable amount of time on the study of the extraction of the lighter metals. One of the initial accomplishments of National Research Corporation in war work was that of perfecting a method of extracting metallic magnesium for use in the aeroplane and allied industries. Particular reference has been made in their research work to heat sensitive materials where the high vacuum technique does a splendid job.

This company is committed under contract for a period of twenty years to devote a percentage of its time and ability to the study of citrus processing and by-products. Its major compensation for this effort will be confined to the increase which it can create in the value of Florida foods as an industry. During this period the National Research Corporation will maintain a separate laboratory in Florida for this research work. That is the background.

Ever since human beings started to travel about on the earth, they have had to carry food with them. After being established in new places, they have always needed food or food products carried or shipped to them. During early times only dried products could be taken. These lacked essential vitamins and resulted in such deficiency diseases as scurvy, beriberi, pellagra, and rickets. With the advent of refrigeration, fresh fruits and vegetables could be carried along or stored for long periods of time, thus providing more palatable food and making supplies of these essential vitamins available for longer periods of time.

Research has shown that the mineral elements and vitamin C that occur in citrus juices when supplied properly not only prevent the deficiency diseases caused by their absences, but enable users to do more work, feel better,

and enjoy life more abundantly. The addition of pure dehydrated orange juice to this list of mineral and vitamin containing food products is a still further step in extending the distribution of these necessary health products.

The use of processed fruits and vegetables and particularly citrus juices has given humanity another method of transporting, storing and reducing to a much less perishable state these necessary parts of the diet. This evolution in packing citrus products is not a new thing. Other branches of the Food Industry have gone through a similar evolution and have emerged with a more stable market and with a consuming public highly satisfied with the results of that evolution. Early in the history of the frozen food industry surveys were made by competent authorities which indicated that approximately 70% of the food consumed in the United States was either processed or refrigerated, or both. You are all familiar with the progress made by the Frozen Food Industry and their aspirations for further increase in future years. It would seem that our problem of processing an increasing amount of the Florida citrus crop should not cause us undue alarm, as other segments of the Food Industry have successfully met this problem. It is true, however, that unless fresh citrus fruits are permitted to go to the markets in proper amounts, the excess amounts which should properly be processed and thus be withheld from fresh fruit sales will cause the entire market to break and a lower price will accrue to the grower.

Briefly, orange juice powder is dehydrated orange juice and contains all the original and natural ingredients except the water. The reconstituted juice made by adding the orange powder to water is comparable to the starting material in both flavor and aroma. There is relatively no loss of ascorbic acid—the important vitamin C.

Although the dried juice or powder is extremely hygroscopic and will, therefore, quickly absorb moisture when exposed to the atmosphere, when vacuum packed in vapor-proof containers it will keep indefinitely at normal room temperatures.

To produce what amounts to a 5 oz. (liquid

measure) glass of fresh orange juice, merely requires stirring approximately 1 oz. (avoirdupois) of orange powder into 5 oz. of cold water. The powder goes into solution in a few seconds and the result is an orange juice having approximately 13% solids.

Florida Foods, Inc. expects its plant for producing dehydrated orange juice to be in operation by March 1, 1946. It is being designed for an input capacity of 20,000 gallons of orange juice per day, with provision being made so that this capacity can be readily expanded to 40,000 gallons per day. The process is carried out entirely at low temperature and the juice is never subject to higher than room temperatures. At one step in the process, a concentrate containing 50% solids is obtained. Present plans call for 2200 gallons per day of this concentrate to be available for distribution and sale as a frozen product. The remainder of the plant will be used to produce 5500 lbs. per day of dehydrated orange juice powder.

The concentrate which contains 50% solids is produced by vacuum exaporation and is immediately frozen, hermetically sealed in air tight containers and stored and distributed at temperatures around 0 degrees F. It has been found that this product retains 95% of the vitamin C in the orange juice and that it will keep for long periods when stored at proper temperatures in the absence of air. One gallon of the concentrate can be converted readily into 4.7 gallons of fresh juice by the addition of water. It is expected that this product will have a wide market especially in the institutional trade.

The orange juice powder is produced by vacuum evaporation in the micron pressure range. The large quantities of water vapor are pumped with rotary condensers which continually remove the vapor in the form of ice. The resulting powder, which contains approximately 1% moisture, is extremely hygroscopic and must be handled and packed in an atmosphere of low humidity. One pound of the powder will produce eight pounds, slightly more than 9/10ths of a gallon, of orange juice. It is well to note that the powder will weigh 1/20th as much as the corresponding amount

of fresh oranges. Vitamin C retention during the processing of this powder is approximately 95% and storage at temperatures between 70 and 80 degrees will result in no appreciable loss of vitamin C.

In shipping oranges the major portion of the weight is made up of water, rind, pulp, and crate. An average crate of oranges weighs 90 lbs. and will produce approximately 4 1/2 gallons of orange juice. An equivalent amount of powder in cans weighs a little over 7 lbs. Moreover, the grave problem of spoilage in shipment is completely eliminated.

A comparison of the cost of containers, labels, and freight for packaging and transportation of fresh oranges, canned orange juice and orange juice powder is as follows:

	Crate Fresh Oranges	Juice from 1 Crate Oranges	Powder from 1 Crate Oranges
Weight Containers & Labels	90 lbs.	45 lbs.	7 lbs.
Freight (Baltimore)	.81*	.2925	.045
Total	\$1.1775	\$.8325	\$.129

* Includes refrigeration.

Conversion of orange juice to powder means several things to several classes of people. It will not crowd the fresh oranges off the fruit stand where shipments may come directly from Florida or California, but will find a receptive market.

To the families in remote sections of the country, on farms, and places not reached by the perishable food distribution system, it will mean a delicious orange drink heretofore unobtainable and an excellent source of vitamin C.

To institutions such as hospitals and schools, restaurants, dining cars, ocean liners, and air lines, it means the elimination of an expensive space-consuming storage problem and an appreciable saving in labor and a dependable

supply of juice consistent in quality.

To millions of housewives it means the end of the annoying, time-consuming squeezing of oranges before breakfast, the cleaning of squeezing apparatus, the disposal of the rinds, and the assurance of the steady source of orange juice at an economical price.

To the orange grower it means that his market can be extended both as to time and space. It is a known fact that Florida fresh citrus fruit, as such, is out of the Northern markets for approximately five months of each year, and that if the public is to have the value of Florida citrus it must secure that citrus in the form of canned segments or juice. This creates the necessity of educating the public to the use of two Florida citrus products, namely, fresh fruit and the canned or processed fruit. It is also true that the months in which Florida citrus is not available in fresh fruit form in the Northern markets are the months in which cold drinks are in the greatest demand. There is a belief that by the use of Florida dehydrated orange juice we may be able to extend the fresh fruit flavor and taste to these Northern markets during those months.

The area west of the Mississippi River and east of the Rocky Mountains comprises an area in which 20% of the population of the United States lives, and because of difficulties and high cost of distribution this market has been practically closed to the sale of Florida fresh citrus fruit. Since the citrus powder equivalent to the amount of orange juice contained in a full box of oranges will be only a

fraction of juice weight, it is hoped that this advantage will enable us to reach such markets and will permit the people in that area to have the advantage of the flavor of Florida fresh fruit at a price which is equivalent to that of fresh orange juice in the Eastern States.

Foreign export markets reached by infrequent and space-limited transportation facilities, which now include air transport, can be supplied with orange juice powder seven times as economically as by canned juice and 9 times as economically as fresh fruit without the attendant hazards of fresh fruit handling. This supply of orange juice powder available in remote corners of the earth will improve health, help to extend prosperous civilizations and improve trade. It is nearly inevitable that the use of oranges will be decidedly increased when the large scale production of dehydrated orange powder becomes a reality on the market.

The personnel of Florida Foods, Inc. fully realize their responsibility in launching such an ambitious program for a new product. Investors have been generous enough to entrust us with millions of their dollars, the citrus industry has been very kind in its commendations and suggestions, and the public has shown a genuine interest in purchasing the product. It is our hope that added manufacturing facilities will be needed to process the Florida citrus crops—and to satisfy the public demand for high grade products of this nature.