THE QUALITY CONTROL OF CHILLED ORANGE JUICE FROM THE TREE TO THE CONSUMER

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For a number of years, due to the compatibility of citrus juice and milk, the citrus and dairy farmers looked for a suitable means of processing and packaging citrus juice for distribution by dairy route trucks. With the advent of chilled orange juice, this was accomplished.

Cartoned, or chilled orange juice as it is commonly called, is a single strength orange juice, marketed in a waxed fiberboard carton. The juice is extracted and treated in such a manner as to retain most of the desirable flavor and aroma which is associated with freshly squeezed orange juice. It is highly perishable in nature, and must be stored or transported under adequate refrigeration in order to reach the consumer in a palatable state. During the past season (1955-56) more than 3,000,000 boxes of Florida oranges were used in production of this product. It is anticipated that during the current 1956-57 season, an excess of 5,000,000 boxes will be utilized. It is the goal of the product control in the Chilled Orange Juice industry to present to the customer—the housewife, the institutional dietician, or the restaurateur—orange juice of such quality, to have more uniformity in flavor and aroma, than juice extracted from fresh oranges themselves.

The selection of the fruit to be extracted is the first and a very important step in quality control of chilled juice. This is accomplished in the groves, where the fruit is tested and tasted at regular intervals for maturity by trained technicians and buyers. When the fruit in the groves reaches its peak of maturity, it is then selected for its quality. The maturity of the fruit is based for all practical purposes on the relationship of the per cent of soluble solids to the acid content, since it has been found that when certain ratios of sugars to acids are found in the fruit, the juice will also have best flavor, color, cloud, vitamin C, and all the other desirable qualities.

Once the particular crops are selected for picking, the steps from the groves to the processing plant, the storage and extraction stages are very similar to that which is performed in other types of citrus juice plants. Extreme care is exercised in properly grading the fruit to be certain that no undesirable fruit enters the line for extraction into the juice.

The juice flows into a stainless steel trough, which is connected to each extractor, and thence into a paddle type prefinisher. The overflow from the prefinisher passes into the screw type finisher. The type and amount of pulp or juice sacks in the finished product is governed by the size of the openings in the screens of the prefinisher. Prefinished juice flows into a surge tank where it is pumped to the blend tanks as pulpy juice is desired.

The juice from the finisher surge tank is also pumped to the blend tanks. From this line a sample is taken every fifteen minutes and checked for brix-acid ratio and rapid peel oil determination (Burdick Method). Through this method of checks, a constant ratio can be maintained by either increasing or reducing the flow of fruit in the bins. From the blend tanks, the juice is pumped through a plate type heat exchange for stabilization of enzymic and microbiological action. Processing time and temperature are carefully controlled so that no significant change in flavor will occur. After stabilization, the juice is rapidly cooled to 32° F. and pumped to a cold wall or refrigerated holding tank. The juice flows by gravity to a milk type filling machine where milk type cartons are filled, sealed, and hand packed in cases. The cases, closed by an automatic sealer, are then conveyed to the cold room for storage and ultimate loading onto a refrigerated truck.
Samples are taken at regular intervals from the production line by a U.S. Department of Agriculture Inspector. These samples are tested for brix-acid ratio, carton fill temperature, and peel oil content. At present, there are no U.S.D.A. grade standards for chilled orange juice, only those regulations set by the Florida Citrus Commission and enforced by the U.S.D.A. Inspector.

Plant Sanitation is the most important part of quality control. Through laboratory tests such as mold counts, microscopic examinations, insect counts, and plating, the cleanliness of the equipment can be determined. After each day's operation, floors, walls, tanks, extractors, and all pipelines are thoroughly cleaned with a strong detergent and sanitized with hot water and chlorine solution.

In less than twenty minutes from the time the orange rolls from the bins, it has been juiced, placed in a carton, cased, and in the cold room ready for shipment.

The advent of mechanically refrigerated insulated trucks has played an important part in expanding the geographical limits of the market for chilled orange juice. Fast trucks equipped with sleeping accommodations for the relief driver or the use of exchange drivers at designated points enroute enable delivery from Florida to New England markets in approximately 36 hours. Control of temperature is so important that spot checks are made, unknown to the drivers, by inserting a specially designed thermograph in one of the cases after removing two of the quart packages.

**Sampling Procedure**

Upon arrival at the destination, spot checks of the temperature of the product in different parts of the load are made; the thermograph is sent to the laboratory together with six quart packages, two each are taken from a case in the rear, middle, and front of the load. One of each pair of samples is set aside for shelf life determination at 45° F. and is flavored each day for four days, then at less frequent intervals until the termination date stamped on the top of each package. The three other paired samples are each subjected to the following tests, net weight of contents, microbiological counts for bacteria, yeasts and molds, pH, brix-acid ratio, and flavor criticisms by two or more experienced persons. One of the three samples from each shipment is analyzed for Vitamin C content. If flavor criticisms indicate a strong peel oil flavor, determination is made for the percentage of peel oil, otherwise this test is omitted.

Standards of satisfactory performance with plus or minus tolerances for each of these measurements have been mutually agreed to by the parties concerned, and close contact is maintained by phone between the Florida and New England laboratories if results indicate an unfavorable trend in compliance with the standards. Deviations from standards call for prompt correction and not necessarily rejection unless it is believed the deviation will result in unfavorable customer reaction.

**Distribution Channels**

When a shipment arrives at the New England plant, it is transferred directly to specially refrigerated chests maintained at 30° F., providing the temperature and flavor at the time of unloading are found to be satisfactory. The temperatures normally maintained for refrigeration of dairy products are not regarded as adequate for the handling of chilled orange juice. Each shipment is kept sufficiently isolated in the storage chest, and records kept of the disposition of each shipment into the various channels of distribution so that it could be promptly located and withdrawn from the market if subsequent tests and especially the progressive flavor development in the shelf life samples indicate that even a slight chance will be taken with customer satisfaction. Great care must be exercised to avoid excessive inventories, and to insure systematic turnover of the loads in the order of their receipt. Close contact between the laboratory and distribution is absolutely essential. Special icing of each case of orange juice on milk routes is necessary to maintain temperatures well below those normally regarded as satisfactory in handling dairy products. Route men have learned to pay critical attention to the termination date on the package and refuse to accept a product which is so near its termination date that the customer will not have time to use it. Routemen have learned the hard way that the distribution of one bad lot of orange juice can result in a greater drop in sales than they can build back in three or four months.

The successful distribution of orange juice depends upon rigid control of four things:
(1) careful selection and skillful blending of fruit, (2) precision in processing, (3) absolute control of temperatures below 35° F. from Florida to the customer's doorstep, and (4) thorough laboratory checking at the processing and distribution end, coupled with unyielding determination to withdraw from the market any product which will jeopardize uninterrupted customer satisfaction.

The distribution of orange juice on milk routes is a natural; it can be done if we face up to the problems of complete control from the tree to the customer's doorstep.

HYDROCOOLING CANTALOUPES

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The growth and prosperity of cantaloupe production in the Southeast depend on placing high quality melons on the market. Hydrocooling tests were conducted during June and July of 1955 and 1956 by workers of the Georgia Experiment Station in cooperation with the Georgia Coastal Plain Experiment Station at Tifton, Georgia. The purpose of the tests was to determine the effect on the marketability of cantaloupes of higher quality.

Information on the rate of heat removal is essential to determine the possibility of hydrocooling cantaloupes. A pilot plant model of a hydrocooler was obtained from a local manufacturer. This equipment was limited to processing two Jumbo crates of cantaloupes at the time. The process involved was practically identical to that of the commercial models sold by this and other manufacturers to hydrocool peaches at rates ranging up to 600 crates or bushels per hour.

Hydrocooling is known to slow the ripening process in other products, and if immature cantaloupes are so treated, they might not have the desired quality. Consequently, cantaloupes for the 1955 tests were picked at three stages of maturity, namely: full slip, showing good color, and full ripe. Tests were made by size of melon and included sizes 36s, 27s, and Jumbos.

In these preliminary tests three thermometers were inserted into the cantaloupes at different positions and readings were recorded at two minute intervals for one hour to obtain the rate of heat removal. Bulbs of the thermometers were placed in the flesh at the stem end, in the cavity, and in the flesh at the blossom end. Results given are from the readings of the thermometers inserted in the flesh, which were practically identical for both positions.

Full slip and full ripe cantaloupes were used for the 1956 tests. Information was obtained on the effect of hydrocooling on the quality of cantaloupes in addition to the rates of heat removal. Crates of cantaloupes at each stage of maturity were hydrocooled and held in storage at 38° F. for eight days. Check crates were placed in the same storage without hydrocooling. At the end of the storage...