# THE DEVELOPMENT, PRODUCTION, TRANSPORTING, AND MARKETING OF QUICK-FROZEN ORANGE CONCENTRATE

Thesis for the Degree of M. A.

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Leonard L. Hart, Jr.

1952

THESIS


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Kenneth Wilson
Major professor

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# THE DEVELOPMENT, PRODUCTION, TRANSPORTING, AND MARKETING OF QUICK-FROZEN ORANGE CONCENTRATE

By

Leonard L. Hart, Jr.

A THESIS

Submitted to the School of Graduate Studies of Michigan State College of Agriculture and Applied Science in partial fulfillment of the requirements for the degree of

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# CHAPTER I

# INTRODUCTION

## Purpose

The purpose of this thesis is to present an insight into the conception of a new industry and the progress for its first years of existence. It is not within the scope of this paper to present a technical report on frozen orange concentrate. Its primary design is to acquaint the reader with a background knowledge of the orange industry first, and then to lead up to the development of one of the most successful packaged foods that we have known in this rapidly growing era of frozen food processing. It is hoped that this presentation will give an insight into the birth, production, and marketing of this new product, which had a retail sales volume of approximately $100,000,000 only six years after it was first produced. During this short time it has become a "must" merchandise for almost 222,000 retail stores.

Due to the large amount of subject material brought into this thesis, it was planned to cover the pertinent points that revealed the development of a new product. However, it is also the intent of these pages to give someone not acquainted with the industry an insight into the concentrate story.

This story is more than interesting; it is a dramatic combination of many things. In 1952, this product had captured one-third of the frozen

food sales but has yet to show a consistent profit to its producers. One of the largest producers of orange concentrate had a $4,000,000 inventory loss in 1951. How can a product be so successful in sales and yet not show a profit for its producers? It is a young industry that is still paying for its cost of development and expansion. However, its one big fault is that no one producing it has made much profit.[1] There are many reasons and facts that may contribute to the cause of this discrepancy. It is beyond the scope of this paper to go into these details except briefly in the last chapter.

## Procedure

The outline of this paper as presented in the table of contents gives the reader a general insight into the procedure followed in connecting the large areas of subject matter contained in a single chapter. These individual chapters involve complete industries within themselves, which are related to the progress that the orange concentrate industry has made. It is the purpose of this presentation to give a "picture view" of some of the situations encountered in the orange concentrate industry's brief but dynamic past as of 1952.

As the outline of chapters and subject matter was pieced together, it was with the intent of trying to give the reader a "round by round" presentation of the story. The second chapter deals primarily with some of the historical facts about the sweet orange. It is this specie

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1. Anonymous. Troubles in Frozen Orange Juice. Fortune. Volume 45 (March 1952), p. 102.

of oranges that is used to produce orange concentrate. Along with this goes some of the aspects of maturity and quality, tree life and harvesting, to give the reader who knows nothing about the citrus industry an approach to its problems.

The following chapters take the form of following the steps that a new product would naturally go through in coming into existence. This starts with the development of the idea and the product and follows it through the production process, transportation and its problems, and the important phases of marketing. This is ended with some conclusions about the industry's past record and some of the unsolved operational problems that it still faces.

It is interesting to note that forty years ago oranges were mainly eaten and not squeezed to produce orange juice, as it is the present custom in some places to do so. It was discovered that the average person ate only half an orange when it was consumed as fruit, but that it would require two or three oranges to fill a six ounce glass. This was in 1915, when the California Fruit Growers Exchange of Los Angeles, California, was seeking a means of increasing citrus fruit consumption. The promotion of oranges for juice by the Exchange had much to do with the popularity of orange juice as a national beverage.[2]

This was just the beginning, because methods were later perfected for canning orange juice in the latter part of the twenties. Although

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2. Anonymous. Frozen Citrus Concentrates. Western Canner and Packer. Volume 41 (October 1950), p. 16.

heat was applied to pasturize the juice, which impaired its natural flavor, this increased the consumption of orange juice tremendously. Researchers continued to look for a way to perserve orange juice and retain its natural flavor as much as possible. There were many different experiments in trying to freeze orange juice as well as to concentrate it. So, when quick-frozen concentrate was developed in 1944, it was a combination of these two methods that retained the flavor and made it possible to produce this product on a commercial scale.

## Sources

In doing research for this thesis, material was gathered wherever it could be found and was available. The writer had previously worked in an orange concentrate plant in Florida and drew a good deal of the information presented here from past experiences.

Other sources of information included published data that were available from the United States Department of Agriculture, trade publications and periodicals, and personal interviews with men in the business. Material was also received from individuals, trade periodicals, and frozen food distributors by writing to them. This was rounded out with state bulletins from the two principal citrus growing areas, California and Florida. Information was also obtained from individual concentrate firms in Florida.

# CHAPTER II

## SWEET ORANGE INDUSTRY

### Development and Spread of the Sweet Orange

Before beginning to trace some of the interesting points in the development of quick-frozen orange concentrate, which is a process of preserving orange juice and its quality, it is best, by the writer's point of view, to present a synopsis of the history of the sweet orange and the spread of its development into this country.

Citrus Sinensis, the sweet orange, is one of the several species of the genus Citrus. Included in the genus Citrus are sixteen species, of which the sweet orange is the best known and most popular. It owes its great popularity almost wholly to its suitability for eating as fresh fruit or for serving as a dessert fruit. In recent years it has gained another form of popularity, that of being served as fruit juice on the breakfast table.

"In the commerce of the world, in market reports, and in general usage, the word 'orange' when used alone usually means the sweet orange; if any other type is intended, it should be specified. The sweet orange is a native of China from where it has spread to other tropical and sub-tropical regions. Most of the varieties now cultivated, however, have originated in those countries into which this orange was introduced and where its commercial culture has become important."[1]

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1. Webber, John H. and Leon D. Batchelor. The Citrus Industry. University of California Press. 1948. p. 500.

The spread of the genus Citrus, to which the sweet orange belongs, has been very slow in its travel from one part of the world to another part. The various species of the genus Citrus are all believed to be native to the subtropical and tropical regions of Asia and the Malay Archipelago and to have spread from there to other parts of the world.

"The first member of the group to become known to the European civilization was the citron, mentioned about 300 B.C. by Theophrastus. For hundreds of years it was the only citrus fruit known. Then came in order, but centuries apart, the sour orange, the lemon, and the sweet orange. The sweet orange was not known until approximately 1400 A.D., about seventeen centuries later than the citron."[2]

There was no reference to the sweet orange preceding the fifteenth century, however, by the beginning of the sixteenth century there was evidence to show that it had assumed commercial importance in southern Europe.

Citrus fruits were not known in America at the time of Columbus and his expedition in 1492. The fact that no Citrus species is indigerous to America is a recognized statement by all authorities. Columbus introduced citrus into America in 1493 in a voyage to establish permanent settlements on the island of Haiti.[3]

The spread of citrus into the Americas was next recorded in Central America around 1554. Citrus was also introduced into Florida about 1565.

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2. Ibid. p. 1.

3. Ibid. p. 25.

The exact date of the introduction is unknown. It is certain, however, that it was brought by early Spanish explorers some time between 1513, when Ponce de Leon first landed in Florida, and 1565, when St. Augustine, the first colony in Florida, was established. Planting of orange trees were also made in South Carolina before 1577. It appears from this evidence that citrus fruits were introduced into several parts of the southeastern United States in the latter part of the sixteenth century.

The early settlers in Florida some two centuries later found wild citrus groves in various parts of the state, some of them many acres in extent, which are supposed to have developed from seeds dropped by the Indians, to whom fruit had been given.

It was from these wild groves that the commercial citrus industry is said to have started. The cession of Florida to the United States in 1821 was about the time of the development of the industry within the state.

Considerable progress had been made until 1835, when a severe freeze killed most of the trees to the ground. Previous to 1835, St. Augustine produced annually from two million to two and one-half million oranges, which were equal in bulk to about fifteen thousand barrels. They were shipped to Charleston, Baltimore, New York, and Boston, and usually brought from one dollar to three dollars per hundred.

These early groves were situated along rivers and the fruit was transported in barrels down the river to the markets. The advent of the railroad into Florida around 1860 provided a means of quick

transportation to the principal northern markets, and from this time on, the development of the industry was rapid.

It is interesting to note that early historical records indicate that citrus fruits reached what is now the state of Arizona before settlement had been made in California, and that Arizona is thus an older citrus growing section than California.

Oranges were successfully grown in southern Arizona in the early days of the eighteenth century and 1707 may be taken as the approximate date of introduction into this region.[4] Citrus growing in Arizona was limited to scattered plantings for home use and it was not until the beginning of the twentieth century that small commercial groves began to appear.

Oranges were introduced into California around 1769, but there are no definite records before this time to verify this date. The first orange grove of any size to be set out in the state was planted in 1804.[5] However, the plantings in California were small and few in number until around 1849, when the "Gold Rush" swelled the population of the state. This was the real birth of the commercial citrus industry in California.

In 1873, the Washington Navel orange, whose origin is believed to have been near Bahia, Brazil, in the early part of the nineteenth century, was introduced into California, which stimulated citrus culture there and formed the naval orange industry that was the "backbone" of the early industry.[6]

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4. Ibid. p. 32.
5. Ibid. p. 333.
6. Ibid. p. 530.

In other sections of the United States where citrus is grown commercially, the industry is of very recent origin. In certain sections of the Gulf States, small plantings of the hardy Satsuma oranges were made as early as 1890, but these were largely killed by frost. In 1910, the United States Census Report gave for Texas a total of 833,406 citrus trees which were mainly Satsumas in the Houston and Beaumont districts. The freeze of 1916-1917 destroyed most of the groves, and in 1920, the census report showed only 123,951 citrus trees in the state. However, the main part of the industry has moved into the Rio Grande Valley of Texas. More than two-thirds of this present acreage out of approximately 60,000 acres is grapefruit.[7]

In these states, California, Florida, and Texas, commercial production is largely located, with smaller plantings in Arizona, Alabama, Louisiana, Mississippi, and Georgia. Earliest records of seasonal volume of citrus production in the United States starts with oranges in California and Florida in 1902.[8] However, the growth of the orange industry in the United States can be shown approximately by the estimated acreage of oranges in the United States, which was compiled in 1944, by age of trees in the three principal areas of production. This table is presented at the end of this chapter.

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7. Ibid. p. 40.

8. U. S. Bureau of Agricultural Economics. Readjustment in Processing and Marketing Citrus Fruits. United States Department of Agriculture, Washington, July 1946, p. 8.

## Productive Life of Trees

From the information contained in this chart, the question is raised, "How long is the productive life of an orange tree?" Very little is known concerning the average productive life because only a small percentage of the trees in the United States are old enough to indicate their average productive life span. Only assumptions can be made on an orange tree's productive life span. However, the end of the productive life is assumed to be the time at which groves will have passed the period of maximum production and declined in annual yield to one-half of their maximum. It is further assumed this period will be reached, on Florida and California oranges, sometime between seventy and ninety years after planting. Distinction must be made between the length of time that the individual trees will live and the average productive life of a commercial grove. It is not to be expected that the commercial groves will be retained until the trees actually die. It is generally assumed that groves will be maintained in production only until such time as their average annual yield declines to one-half of their maximum yield.

In 1944, there were about 650,000 acres of oranges in the United States. In most areas, the trees continue to increase in size and bearing capacity over a long period of years. Orange trees in California and Florida do not reach their heaviest production until about forty years of age. In other areas, maturity is attained somewhat earlier than in California and Florida.

## Varieties

It is interesting to note the differences in growing seasons in the principal sweet orange commercial regions. California has a decidedly better advantage than Florida in this respect. Whereas Florida oranges in the fresh form are only available six or seven months out of the year, California has fresh fruit available for twelve months of the year.

In California, where much attention has been given to standardization, two varieties, the Washington Navel and the Valencia, are grown almost exclusively. These varieties owing to the length of time that they may be held on the tree in prime condition, completely cover the season and provide fresh fruit at all times of the year. The Washington Navel begins to ripen in northern California in November, and the main crop season extends to April and May. The Valencia begins to ripen in March or April, and the season extends to September or October. All other varieities in California are to be considered of very minor importance.

In Florida and other sections of the United States where less attention has been given to standardization, more varieties are grown. The varieties of oranges in Florida fall into three general classes, early, midseason, and late varieties. Early varieties will ripen in late October and November and they consist mainly of Hamlin and Parson Brown species, with Hamlin gaining in preference. The midseason varieties are ready to pick during December, January, or February with Pineapple being the dominant one, although some Homosassas and Jaffas

are still propagated. Among the late-ripening varieties, which begin to ripen during March and are picked until early summer, the Valencia is most widely planted but the Lue Gim Gong is planted to some extent, particularly in the lower east-coast region. Many varieties not mentioned are still grown but are no longer being propagated. For commercial concentrating, Pineapples, Valencia and seedling oranges are generally used in Florida, and Valencia and Navel oranges are used by concentrating plants in California.

## California Varieties

The Washington Navel orange, which was first imported from Brazil in 1870 by the United States Department of Agriculture, was sent to Riverside, California, under the name of Bahia. This variety, however, became more commonly known as the Washington Navel and Riverside Navel and was distributed under these incorrect names.

In California, the Washington Navel is considered superior to all other early or midseason varieties and is the only early sweet orange to be extensively grown commercially. During the time from 1880 to 1890, owing to its widespread popularity in California, the Washington Navel was planted extensively in Florida, but proved to be too poor a bearer in that state to be successful. This variety is very susceptible to injury from drought during the early stages of the development of its fruit. Florida has a dry period in April and May, which occurs normally every year, and which causes too excessive a loss of fruit by dropping from the tree to permit this variety of sweet orange to be used as a commercial producer.

The Valencia orange was introduced into California in 1876 by A. B. Chapman and George H. Smith, who received an unlabeled package of orange trees from a nursery in England. Chapman planted and grew these trees and only one variety of this group proved to be of value. This was the one that Chapman at first called the Rivers Late. Later, a citrus grower from Valencia, Spain, identified the variety as one grown in Spain. Chapman then adopted the name Valencia Late, by which the variety has come to be generally known.[9]

The basic value of the Valencia is that it is a late-ripening variety that comes into bearing without competition from other varieties being on the market at the same period of time. The Valencia has been introduced into virtually all citrus sections of the world and is unquestionably the most important late-maturing variety grown. It is more extensively grown than any other orange in California, Florida, and Texas, and is doubtlessly grown more widely and on a larger acreage than any other citrus variety in the world.

## Florida Varieties

Early Varieties: The Parson Brown is one of the older varieties of early oranges produced in Florida. It originated about 1878 as a seedling in the grove of Parson Brown at Webster, Florida. It is recognized as one of the best early-maturing oranges and production is heavy in Florida. It is also grown to some extent in Texas, Arizona,

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9. Webber. Op. cit. p. 523.

and Louisiana.[10] It has not proved successful in California, where the Washington Navel matures at the same time of year. The season on Parson Browns is mostly in October, November, December, and usually part of January.

Another early variety in Florida is the Hamlin which is one of the newer early varieties. It originated in a grove near Glenwood, Florida, in 1879, but has been planted extensively only in recent years.[11] It fruited in California for the first time in 1933 and has thus not been thoroughly tested there but it is one of the most widely planted early oranges in Florida.

Midseason: The Pineapple is one of the most widely grown midseason oranges. It originated as a seedling on the James B. Owens grove near Citra, Florida.[12] It was not until the 1890's that the Pineapple was generally planted as a midseason variety. It has a rather unusual name for an orange and was first called the Hickory orange but later on it was changed because of its similarity of odor to that of the pineapple. While it is probably one of the best flavored oranges grown in Florida, its chief disadvantage is the heavy production of other midseason fruit, plus the fact that it contains twelve to twenty seeds.

The Homosassa originated as a selected seedling in the grove of Mr. Yulee at Homosassa, Florida. Up until 1907, it was listed as one

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10. Webber. Op. cit. p. 507.

11. Florida Department of Agriculture. Citrus Industry of Florida. Tallahassee, Florida, October 1951, p. 31.

12. Webber. Op. cit. p. 514.

of the three best midseason varieties and many groves still exist in Florida. It has been planted also to a limited extent in California, Texas, and Louisiana, but because it is too seedy, it is no longer planted in new groves.[13]

The Jaffa, a Palistine orange, was first introduced into Florida around 1883 and spread from there to all citrus growing regions of the United States. Many groves of this variety still exist in Florida and there are a few in California, but the Jaffa has been largely superseded by the Pineapple in Florida and by the Washington Navel in California.

In the early history of Florida, citrus production was based largely on extensive seedling groves, and while no considerable acreage of seedlings has been planted for many years, the seedling groves that are still in existence furnish a very substantial portion of the tonnage of fruit in Florida. A seedling orange tree is one that grows from its own seed and is grown on its own rootstock.

Late Varieties: The Valencia was introduced into Florida around 1870 through two separate shipments; one was sent to General Sanford of Palatka and the other to E. H. Hart of Federal Point. Later, it was discovered that these varieties were identical with the Valencia of California, so that the name of Valencia for this orange is now commonly accepted.[14] Seeds are usually few and seldom over six. The Valencia crop is usually picked from March to July in Florida. At present, it constitutes the main crop of late oranges in Florida.

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13. Webber. Op. cit. p. 510.

14. Webber. Op. cit. p. 525.

## Maturity and Quality

It is important to note that oranges do not improve appreciably in quality after being severed from the tree. In this respect, oranges are different from apples and pears. If oranges are not ripe enough to eat when they are picked, they never will be. It is, therefore, necessary that oranges must be of a desirable eating quality at the time of harvest. As long as the oranges hang on the trees, their composition is continually changing.[15]

In trying to judge the maturity and quality of oranges, there are several important factors to consider. One of the most common methods of casual judgment of maturity is that of color. However, this does not always run true to form as a criteron in judging the maturity of oranges. A deliciously flavored fruit may have a green-colored rind, whereas, a sour unripe one may have lost all its green color because of various varietal characteristics, climatic conditions, or cultural practices. The method by which maturity or the internal quality of oranges is best determined is by correlating the physical characteristics and the chemical composition to determine when harvesting should be done. However, in trying to determine a definite maturity test, seasonal changes in texture, color of rind, and juice flavor must be taken into consideration. Citrus fruits are grown to be consumed in one form or another. If they are not "good to eat," the fact that they pass some chemical test will not make consumers consider them ripe.

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15. Rose, Dean H. and Harold T. Cook and W. H. Redit. Harvesting, Handling, and Transportation of Citrus Fruit. United States Department of Agriculture, Washington, Bibliographical Bulletin No. 13, January 1951, p. 53.

This explanation of maturity does not attempt to be complete or consider all of the complex factors that are present in a complete maturity or quality determination. It is important to mention that there are specific federal regulations and state requirements to be met before oranges can be processed into quick-frozen concentrate.

Before oranges can be shipped to market in the fresh fruit form or processed into juice, they must meet the established legal standards of maturity in the state where they are grown and the regulations of the Food and Drug Administration of the Federal Security Agency. During recent years, most citrus growing states have raised their maturity requirements. These requirements vary from state to state. In Florida, the present standards consist of a "percentage break" in rind color, which means that a certain amount of the orange must have turned from a green to an orange-yellow color. Other requirements that have to be met are a minimum juice volume, a minimum total soluble solids and a graduated solids-acid ratio. In general, the higher the solids, the lower the required ratio.

In explaining these last requirements of maturity, a definition needs to be given for "soluble solids." For all practical purposes and to give a more clear, but not technical definition, it is best to let "soluble solids" be known as the total sugar content of the fruit. Consequently, it makes possible, in rather general terms, a simple definition of solids to acid ratio. This ratio, then, tells of the amount of sugar or sweetness present in relation to that of acid or flavor characteristics in the orange. If either one of these is

considerably out-of-balance with the other, a poor eating-quality of fruit results.

The lowest ratio of solids to acid used in Florida for concentrating is around twelve to one. This means that for every twelve parts of sugar or sweetness present, there is one part of acid present. The general range is from twelve to one up to seventeen to one for fruit to produce a good quality concentrate.

Fruit upon arrival at the concentrate plant is checked by federal inspectors for maturity before it is processed by the plant. This is just the beginning of quality control in the production of quick-frozen orange concentrate. The aspects of quality control will be taken up again in the chapter on processing.

## Harvesting

Usually, the fruit is checked for maturity before a grove is picked. This is especially true at the beginning of the season for any particular variety of fruit. In picking oranges for fresh fruit markets and those going to the cannery, there is some difference in the methods used. However, the following paragraphs are limited to fruit picked for canneries.

After picking and harvesting fruit for canning plants, the large semi-trailers are used to haul the fruit from the grove to the cannery. A picking crew of from twelve to fifteen men picks the fruit from the trees with the use of ladders. These ladders range from ten to thirty-six feet in length. Some oranges must be clipped from the trees while others may be pulled. The picker carries a picking bag over

his shoulder and hanging at his side. The capacity of this bag is about half a field box. The inside dimensions of a Florida field box are thirty-one and a half inches in length, twelve inches in width, and thirteen inches deep. When filled, this box weighs approximately 100 to 120 pounds, depending on the fullness of the box. The average empty weight of the box is approximately seventeen pounds. The field box used in California is somewhat smaller and lighter in weight than the field box used in Florida.

As the pickers fill their boxes, they are hauled to the edge of the grove or a nearby road where the trailer is located. The fruit is then dumped into this large semi-trailer which hauls the fruit to the canning plant.

Upon arrival at the canning plant, samples of the fruit are taken. These samples are checked to see if the truck load of fruit meets the various maturity requirements. If the fruit passes the required maturity and quality standards it is unloaded into the storage bins of the canning plant.

Oranges are bought on the basis of weight. In that way the entire truck load can be weighed and the tare weight of the truck subtracted to give the actual weight of the fruit. The price actually paid for the fruit is on a per box basis. To arrive at this figure, ninety pounds is used as the standard weight of a box of oranges. This method provides a very uniform procedure on which oranges can be bought by canning plants.

## Summary

This chapter was written to give a limited introduction into some of the basic facts of the sweet orange industry in this country and mainly in the states of California and Florida. These two areas are the principal orange growing regions in this country, as far as commercial production is concerned. It also was the purpose of this chapter to show the principal varieties of sweet oranges that are grown commercially in these main regions and to bring forth a brief historical background of their introduction into this country. This was followed up with a definition or the basis for defining the maturity and quality of oranges. This one aspect is very important to understanding the quick-frozen concentrate method for processing orange juice. As this process preserves the quality of the fruit juice in a form as nearly as possible to that of fresh fruit, nothing is done to add or detract from its quality. This means that only good quality fruit should be preserved if the consumer is to like and continue to buy the product. Finally, a brief description was given on the harvesting operations of oranges.

TABLE I

ESTIMATED ACREAGE OF ORANGES IN UNITED STATES IN 1944
(by age of trees and by states)[16]

| Age of Trees in 1944 | Period When Planted | California | Florida | Texas | Total |
|---|---|---|---|---|---|
| Years | | Acres | Acres | Acres | Acres |
| 0-4 | 1940-44 | 5,950 | 48,619 | 14,450 | 69,019 |
| 5-9 | 1935-39 | 12,300 | 49,136 | 3,106 | 64,542 |
| 10-14 | 1930-34 | 35,350 | 42,437 | 6,909 | 84,696 |
| 15-19 | 1925-29 | 40,200 | 61,199 | 13,732 | 115,131 |
| 20-24 | 1920-24 | 24,700 | 57,586 | 2,591 | 84,877 |
| 25-29 | 1915-19 | 36,000 | 38,924 | 771 | 75,695 |
| 30-34 | 1910-14 | 13,000 | 16,757 | 30 | 29,787 |
| 35-39 | 1905-09 | 7,200 | 11,000 | 30 | 18,230 |
| 40-44 | 1900-04 | 6,500 | 7,293 | 15 | 13,808 |
| 45-49 | 1895-99 | 17,200 | 3,040 | | 20,240 |
| 50-54 | 1890-94 | 13,400 | 3,000 | | 16,400 |
| 55-59 | 1885-89 | 12,700 | 3,000 | | 15,700 |
| 60-64 | 1880-84 | 7,000 | 2,250 | | 9,250 |
| 65 and older | 1875-79 | 14,500 | | | 14,500 |
| Total | | 246,000 | 344,241 | 41,634 | 631,875 |

16. Source: U. S. Bureau of Agricultural Economics. Readjustment in Processing and Marketing Citrus Fruits. United States Department of Agriculture, Washington, July 1946, p. 160.

## CHAPTER III

## DEVELOPMENT OF QUICK-FROZEN ORANGE CONCENTRATE

### Present Process, Basic Principals

The process used for the commercial manufacture of frozen citrus concentrate was developed in 1944. It is based primarily on three operations. The first of these is the removal of water from the juice by evaporation under vacuum at low temperatures. This is done so that the natural flavor of the juice is not impaired or given an off-flavor by the application of heat. The second step is the blending of the concentrate juice with a quantity of fresh juice which is called "cut-back." This is done to give the finished product sufficient fresh fruit aroma and flavor. The third and final step in processing is the quick-freezing of the concentrated juice.[1] This is a very brief summary of the present commercial process of manufacturing orange concentrate.

There were many factors and concurrent situations which led to the discovery of quick-frozen orange concentrate that could be produced on a large commercial scale. This new product made such an impact in the food field with its rapid growth that it is considered to be one of the most successful packaged foods. However, the basic principles behind

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1. Wenzel, F. W., C. D. Atkins and Edwin L. Moore. Frozen Concentrated Orange Juice--Past, Present and Future. Reprinted from the Proceeding of the Florida State Horticultural Society, Tampa, Florida, November 1949. p. 3.

this process are by no means new and recent discoveries. In the past, orange juice has been processed and preserved by freezing single-strength juice, concentrating by the removal of water, canning of pasturized juice, and by dehydrating into powder. The combination of several of these methods with the addition of one new feature, "cut-back" juice proved to be the key to the problem.

## Previous Attempts At Concentration

The first patent for concentrating juices by dehydration was applied for in 1899 by August Gurber, a German chemist, and was granted in 1903. Eudo Monti of Italy also obtained a number of patents between 1902 and 1908 for a similar process, but these processes never reached commercial use.[2]

Experiments in removing water from orange juice by boiling have been under way for the past twenty years. There had been a manufacturable concentrate before 1944, but it had certain disadvantages. This method provided for the concentration of the juice, although hot pasturization of the product is necessary. The product is now known in the industry as a "hotpack" concentrate. It did not need to be kept under refrigeration, but its taste was affected by pasturization. Heat can not be applied to orange juice without changing the flavor. However, it did not find much retail acceptance, and its chief consumers were the British during the critical food shortage period in World War II.

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2. Abbott, Bill. Development of Frozen Citrus Concentrates. Tampa, Morning Tribune, April 1950, p. 4.

Another partially successful effort to concentrate orange juice was conducted by Dr. Arthur L. Stahl around 1942 at the University of Florida. The process he tried to perfect was a method of concentrating the juice by half-freezing it and expelling the water with a centrifuge. He worked out many of the defects and brought this process from the laboratory to the pilot-plant stage. This process had too many unsolved problems to be produced on a commercial scale, however. From these experiments conducted by Dr. Stahl, there was a revival of interest in finding a better process of preserving orange juice. It was also through these experiments that the idea was finally developed of freezing a concentrated juice.[3]

## Previous Attempts In Freezing

Previous efforts had been made to freeze orange juice during the latter part of the twenties and the early thirties. California was the first to offer a commercial pack of single-strength frozen orange juice in 1928. The firm that first produced this product was the Golden Health Products Company of Long Beach, California. The death of its owner a year later caused the company to suspend operations.

Two Florida organizations were next in the single-strength frozen juice field. They were the National Dairy Company, whose period of operation was in 1929-30 and Borden Farms in 1930-31. Both organizations suspended operations after one season. Their product was packaged in

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3. Conner, John. The Industry That Laid A Golden Egg. Collier's. Volume 126 (August 12, 1950), p. 27.

a paper container.[4] The main disadvantage of this type of product was that it did not thaw-out quickly into a usable form. This was one of the principal disadvantages of frozen single-strength orange juice, along with the necessity of keeping it frozen in an era when refrigeration equipment of this nature was not in common use. It did have a limited acceptance and was still being produced in small quantities by California concerns in 1946.

These are some of the first commercial efforts to preserve orange juice by the two basic methods, the process of concentrating and the process of freezing single-strength juice. Neither of these methods were very acceptable for large scale production for various reasons. Achieving a satisfactory method of preserving the taste as well as the product and adapting the results to mass production has always been a big problem. All of the methods, previous to the discovery of the quick-frozen orange concentrate, have met with one of these stumbling blocks that limited the success, if successful at all, to a very small commercial production.

## Development and Patent Rights

It was from this background that the simple, but effective, idea of producing frozen concentrated orange juice was developed. There are many people who claim the honor of developing this process. However, the man who gets official credit for the idea that created a new

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4. Anonymous. Frozen Citrus Concentrates. Western Canner and Packer. Volume 41 (October 1950), p. 17.

industry is Dr. L. G. MacDowell, the director of research for the Florida Citrus Commission. Co-workers and developers of the process were C. D. Atkins and Edwin L. Moore, who were on loan to the federal government for concentrate research at this time and were working with the Department of Agriculture at the United States Citrus Products Station in Winter Haven, Florida.[5]

This process was discovered in April, 1944, and is covered by United States Patent Number 2,453,109, which was granted in 1948 to MacDowell, Moore, and Atkins. The patent for the process was assigned to the United States of America, to be controlled and represented by the Secretary of Agriculture.[6] No royalties have ever been paid for the rights of this basic process that all major concentrate manufacturers are now using to process oranges into frozen concentrate.

## Process Details

The main thought and idea behind this patented process is the adding of "cut-back" juice, the addition of fresh juice, to the concentrated juice product. Then, instead of pasturizing the juice by the application of heat, the procedure was changed to quick-freezing the product to zero degrees Fahrenheit. The addition of "cut-back" juice restores the taste of the fresh juice flavor that is lost to some extent in the evaporation process. It also allows the easy re-introduction of pulpy juice cells from the pulpy content of the orange and

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5. Conner, John. Op. cit. p. 27.

6. Wenzel, F. W., C. D. Atkins and Edwin L. Moore. Op. cit. p. 2.

makes possible a better quality control of the consistency and taste of the finished product. To add this "cut-back" juice (natural strength juice) to the concentrated juice without diluting it to a lower level of concentration than desired, the concentrated juice must be over concentrated to allow for this "cut-back" juice to bring it down to the required level of consistency. This subject will be treated in a more complete manner in the next chapter.

## Resume of Development Period

During the 1943-44 season, research on a method to concentrate orange juice was in progress by the Florida Citrus Commission in Lakeland, and in cooperation with the United States Department of Agriculture's Citrus Products Station in Winter Haven. Using equipment and methods planned by L. G. MacDowell, director of research for the Florida Citrus Commission, and J. L. Heid, then director of the Citrus Products Station, MacDowell, Moore, and Atkins concentrated orange juice without modifying the taste. This was done with the addition of "cut-back," or unconcentrated, juice.[7] This product, when reconstituted, added with the required amount of water, could not be distinguished by most tasters from the freshly squeezed juice.

This was the go-ahead signal for several companies to produce this new product on a commercial basis. In 1944-45, these firms were in the process of setting up equipment and running pilot tests that

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7. Heid, J. L. and C. G. Beisel. Improved Citrus Concentrates Depend on Advanced Techniques. Food Industries. Volume 20 (April 1948), pp. 78-81.

could give valuable information for the establishment of full scale operations. There were several organizations in Florida doing this about the same time with different types of equipment. There is some conflicting information pertaining to the actual beginning of commercial production of orange concentrates and several first-to-do-so claims. This presentation will try to present an over-all picture of the situation, but only as accurately as certain conflicting references will permit.

Juice Industries, who market their product with the Snow-Crop brand name and are located in Dunedin, Florida, was producing a "hotpack" concentrate during World War II and experimenting with low-vacuum equipment. In 1945, they produced a cold and refrigerated, but pasturized, product that had been "cut-back" with unconcentrated juice, which is more of a processed concentrate and not identical to the present quick-frozen concentrate. A thousand cases were test-marketed with great success in Washington, D. C., Philadelphia, and New York. A severe test was given the product by the People's Drug Company in Washington, who were sold two carloads. They served this concentrated product to their customers as fresh orange juice. In a two-week trial period there was only one customer who complained and was promptly given his dime back.[8] This was the first market attempt to sell a frozen concentrated orange juice product.

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8. Conner, John. Op. cit. p. 26.
Anonymous. Troubles in Frozen Orange Juice. Fortune. Volume 45 (March 1950), pp. 102-105.

Shortly after Juice Industries placed its product on the market, its plant was destroyed by fire. No one else was producing a frozen concentrate at this time. Vacuum Foods, now known as Minute Maid, was using low-temperature equipment to produce an orange concentrate powder at Plymouth, Florida. They thought an orange concentrate powder was the solution to the problem and were trying to develop it. The type of equipment they were using was developed by the National Research Corporation in Boston during the war. This form of low-temperature equipment had previously been successful in drying out penicillin, blood plasma, and streptomycin into powder form. In 1943, National Research was asked to develop an orange powder for use in Army hospitals, which was not very successful from a retail sales point of view, especially after the war. These were the circumstances which led them into the frozen concentrate picture in 1945.[9]

As it happened, one of the stages in concentrating orange powder involved the manufacture of liquid concentrate. To meet operation expenses, Minute Maid offered to freeze orange concentrate for marketing under the Snow Crop label. Juice Industries, Snow Crop, without plant facilities because of their recent fire, agreed to this arrangement. Together these two pioneer concentrators packed only 226,000 gallons of concentrate during the 1945-46 season. About half of this total was produced by Vacuum Foods, Minute Maid, and sold by Snow Crop on an institutional basis, as there were few retail sales that season.[10]

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9. Ibid.

10. Ibid.

Snow Crop was sold to Clinton Foods in the early part of 1947 and Minute Maid started to sell the concentrate it produced under its own brand name of Minute Maid. There were many small companies that began producing orange concentrate about this time and this brought many new brands on the market. One of the most outstanding companies was the Florida Citrus Canners Cooperative in Lake Wales, which received the 1949 Food Industries' Award for technological achievement in food processing. This award was for producing a high-quality orange concentrate. This rapid development of production capacity was so fast that Florida had nineteen plants in 1951.

California did not produce orange concentrate until 1948. They were in the process of converting plants and equipment in 1947 but did not produce a commercial pack until 1948. California's concentrate industry has not expanded as fast as Florida firms have for several reasons. One of the primary differences is that Florida oranges are better suited for concentrating because of the larger sizes of fruit and the higher solids content of the fruit. Most of California's concentrate plants are located near Los Angeles and had increased to eight plants in 1950.[11]

## Progress

In its rapid development, frozen orange concentrate has shattered records as fast as it has made them. This is evidenced by its record

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11. Western Canner and Packer. Op. cit. p. 21.

given in Table Two that shows where production was not only doubled but tripled in a year's time.

Considering the fact that frozen concentrate is not produced the year round in either California or Florida, these are tremendous production gains. Florida produces the major part of its concentrate from December to June. This includes most of the mid-season and late varieties of fruit. California packs frozen concentrate only during the Valencia season, which extends from April through October. Now in the midst of the seventh season of production, 1951-52, concentrators are talking of producing 43,000,000 gallons of which 35,000,000 will come from Florida. On the basis of present national production capacity of more than 300,000 gallons of orange concentrate in a day of twenty-four hours, the total Florida output for the 1945-46 season could have been produced in a matter of hours. At the same time California will expect to produce around 8,000,000 gallons for the 1951-52 season. This is a considerable gain for California too, considering that they first produced frozen orange concentrate in the summer of 1948 and that the pack reached 3,490,000 gallons in the 1949-50 season.[12]

With all of this tremendous production, it was only in July of 1950 that the sale of frozen concentrate caught up with canned orange juice sales. Since that time they have been ahead of canned juice in sales. In August of 1951, orange juice concentrate went beyond the sales of

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12. Anonymous. Frozen Food Factbook. New York: National Wholesaler Frozen Food Distributors, Inc., 1952, p. 61.

TABLE II

PRODUCTION OF FROZEN ORANGE JUICE CONCENTRATE
(in gallons)[13]

| | Florida | California-Arizona | Total |
|---|---|---|---|
| 1945-46 | 225,684 | ----- | 225,684 |
| 1946-47 | 559,309 | ----- | 559,309 |
| 1947-48 | 1,935,868 | 437,376 | 2,373,244 |
| 1948-49 | 10,232,831 | 1,963,035 | 12,195,866 |
| 1949-50 | 21,647,000 | 3,490,000 | 25,137,000 |
| 1950-51 | 30,757,656 | 5,161,327 | 35,918,983 |

13. Source: Anonymous. Frozen Food Factbook. New York: National Wholesale Frozen Food Distributors, Inc., 1952, p. 33.

fresh oranges for the first time. Yet the consumer markets appear to be far from the saturation point, for in no month has orange concentrate been purchased by more than 22 percent of the householders, according to the National Wholesale Food Distributer's figures in the 1952 Frozen Food Factbook.[14]

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14. Ibid. p. 33.

# CHAPTER IV

# PRODUCTION

## Definition of Concentrating

Concentrating orange juice simply means that part of the water content of the orange juice is removed. If one puts a pan of orange juice over a fire and boils it, the water would become hot enough to evaporate off, and in a short period of time, he would have a sticky, gummy concentrate base of orange juice. This is essentially what takes place in the "hotpack" method of producing a processed concentrate.

In the production of quick-frozen orange concentrate, the juice is subjected to heat, but it never gets hotter than room temperature. This temperature range is from fifty to seventy-five degrees Fahrenheit. The principle of the low-temperature-high vacuum process is easy to understand. When orange juice is boiled at sea level, it must be heated to 212 degrees Fahrenheit in order to evaporate the water from it, but if the atmospheric pressure is reduced, it will boil at a much lower temperature. To give an example of this: If you have ever driven your car to the top of a mountain, you may have found that the radiator was boiling by the time you reached the top. This phenomenon is caused by the thinner atmospheric pressure at the top of the mountain. At the top of a mountain 14,000 feet high, water will boil at 187 degrees Fahrenheit. If you could manage to take orange juice up to

105,000 feet you would only need fifty-five degrees of heat to cause the water to evaporate. This is essentially what takes place inside the evaporator units. A vacuum is present that will allow the water to evaporate off at temperatures between fifty to seventy-five degrees Fahrenheit. Since this is no warmer than the average temperature in the areas where oranges are grown, no damage is caused by this small application of heat. Approximately 90 percent of the water is removed by this process.

There is an industry term that is used to denote the amount of concentration. This term is "Brix." It can be defined as the amount or percent of sugar or solids present. This is not a strict definition of the term, but it will do for an illustration here. When the term "forty-two degrees Brix" is used, it means that 42 percent of the juice is solids. This term will be used later on to describe the actual evaporation and processing of the juice.

## Steps in Processing the Juice

Before taking up the actual steps that the oranges go through to be processed into frozen orange concentrate, it might be best to present a few facts about concentrating.

The family size container for orange concentrate is a six-ounce can, which holds the juice from eight to ten average size oranges. This amount of concentrate, upon being reconstituted with water, yields a pint and a half of juice. Just recently, a twelve-ounce can has been placed on the market for consumers with larger families. It takes the

equivalent of a standard one and three-fifths bushel box of fresh oranges to produce one gallon of concentrate. Quart containers and the slightly smaller twenty-seven ounce cans are popular with the institutional trade.[1]

The beginning step in the concentrate plant is when the fruit is brought and placed in the bins. In the outline of harvesting procedure in Chapter II, this was mentioned. The fruit was checked for quality and maturity and bought on a weight basis of ninety pounds of fruit as the average weight per box. Representative samples of the fruit are automatically taken and tested for "Brix," acid, and juice yield. This is a very important step, because it furnishes the knowledge necessary to begin the blending and quality control program that is so necessary in producing good quality orange concentrate.

The fruit is dribbled out onto a conveyor belt from the bins as it is needed. All of the cut and damaged oranges are removed by graders. This is a small but important task, because in this continuous process, the fruit juice is not pasturized. The bacteria content that is present in the fruit and is allowed to accumulate in the processing equipment gets into the juice and remains there. Consequently, sanitation is a very important and closely supervised operation. The fruit is then sent through a brush-and-spray washer that uses a detergent solution for cleaning. After passing through this washer the fruit is again graded

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1. Anonymous. Special Report. Florida Citrus Commission. Lakeland, Florida. January 8, 1951, p. 2.

and the "culls" and rejects are removed. Then the fruit passes under a chlorine spray that sterilizes the outer surface of the orange.

The next step is that of extracting the juice from the orange. There are several different methods and types of equipment to do this job. Usually the oranges are machine-sorted for size and diverted into extractors that handle each particular size of oranges. The juice flows in stainless steel troughs to the finishers, which are the next step.

The finishers strain the juice and remove the seed and pieces of orange peel and other foreign matter that are present in the juice. Two finishers are generally used, the first one has 0.027 inch holes in the screen and handles approximately 80 to 90 percent of the juice. The second finisher, with a one-eighth inch screen, handles approximately 10 to 20 percent of the juice. This finisher supplies the pulpy juice, which contains pulp and juice sacs, and is held in a cold wall tank at a temperature of thirty-four degrees Fahrenheit. The juice held in this tank is called "cutback" juice and will be used later to blend in with the concentrate juice. The flavor of the natural juice is retained by adding this "cutback" juice to the concentrate.[2]

Pulp-free juice from the first finisher is pumped into a balance tank that feeds into a vacuum deaerator. This removes the air from the juice and cools the juice to around forty degrees Fahrenheit. It is from this tank that the evaporators are supplied a continuous flow of juice. Usually the deaerator tank has a large enough capacity when full

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2. Anonymous. Frozen Concentrated Citrus Juices. Food Industries. Volume 21 (July 1949), p. 66-68.

to keep the evaporators in operation for thirty to forty-five minutes. This is done so that the extracting equipment may be stopped and cleaned at stated intervals.

From this holding tank, the juice goes into the evaporators, where the water is evaporated off and condensed back into water. This is an extremely fast process where the soluble solids content is raised to sixty degrees "Brix" within four minutes.[3] These evaporator units are rated by the amount of water vapor they can withdraw in an hour. The largest evaporator in Florida is capable of removing 68,000 pounds of water vapor an hour. Equipment of this capacity should produce between eight and nine million gallons of concentrate during a season of operation.

In a plant with 20,000 pound evaporators, it requires around 3,000 to 3,500 gallons of juice an hour to keep it operating at top speed. This would require approximately 700 boxes of oranges an hour or between 14,000 to 16,000 boxes in a twenty-four hour operating period. Concentrate plants run twenty-four hours a day during the fruit season.

The percent of solids is about sixty degrees "Brix" when the concentrate comes from the evaporator units and has been subjected to temperatures of fifty to seventy degrees Fahrenheit, depending upon the rate of flow and the vacuum maintained in the evaporator units. From the evaporator, the concentrate juice is pumped to the blending

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3. Heid, J. L. and C. G. Beisel. Improved Citrus Concentrates Depends on Advanced Techniques. Food Industries. Volume 20 (April 1948), p. 81.

room. Here the juice is held in cold wall tanks at approximately twenty-six degrees Fahrenheit. The "cutback", (unconcentrated juice) is then mixed in with this concentrated juice until the desired amount of consistency is obtained. This figure is 41.5 to 42.5 degrees "Brix" for orange juice.

The blended juice is then pumped through volators which slush-freeze the juice to seventeen degrees for vacuum filling into cans. The filled cans are then sent into an air-blast tunnel on a conveyor belt where they are quick-frozen. The temperature of this tunnel is between minus thirty to minus forty degrees Fahrenheit. A continuous belt carries the cans through the tunnel. It will take approximately twenty to thirty minutes to reduce the center temperature of a six-ounce can to zero degrees. From this tunnel the cans are packed in cases, forty-eight six-ounce cans to a case, and are placed in refrigerated storage rooms. These cases are stored on wooden pallets in a storage room that maintains a temperature of minus ten degrees Fahrenheit.

There is a difference in the way that Florida and California concentrates are blended. In the Florida orange concentrate, nothing is added to the juice; it is just a processed product. However, in the case of some California concentrates, sugar is added to the juice because of the low solids content of California oranges. When sugar is added to the concentrate, it takes approximately one less box of fruit to get the same amount of concentrate yield as a concentrate that has no sugar added. In other words, three boxes of fruit plus the addition of sugar, equal the same amount of concentrate yield that is

received from four boxes of fruit when processed into concentrate. Some of the larger firms now pack and market only Florida orange concentrate because of the low percent of solids obtained in California fruit.

## Sanitation

Since most concentrate plants operate on a twenty-four hour basis, sanitation is a constant problem. The equipment, that is exposed to room temperature and not under a vacuum or refrigeration, is cleaned often. The actual frequency of this will vary in different plants. Some clean their extractors, finishers, every four to six hours. This is because the equipment is open and subjected to room temperatures. These cleanup periods are scheduled at stated hours during an operating day. After each cleanup period, samples of juice are taken from each individual piece of equipment. This sample is then tested for bacteria count which indicates how well the equipment was cleaned.

Samples are also taken from all parts of the plant to see how high the bacteria count is in the processing equipment. These samples are then checked in a laboratory. Along with these sanitation tests taken on the equipment, checks are made on the finished product. Cans of concentrate are spot-checked to reveal the amount of bacteria present in the finished product. This juice is by no means unfit for human consumption. What this count of bacteria shows is the amount of microorganisms present in the juice. This does not mean the juice is prepared in an unsanitary manner. The average housewife would have just as high

a bacteria count from the oranges she squeezes in her own home. Some of these organisms are harmless, others cause an acid taste in the juice, and others cause spoilage of the juice.

There is at the present time a relatively small amount of information available regarding the microorganisms present in citrus juices. In the canned single-strength juices, there is no danger of spoilage because the product is pasturized. However, the recent development of unpasturized, frozen orange concentrate has created a need for this type of information. It has been determined to a limited extent that bacteria, rather than yeasts, are the predominating organisms present. It has also been found that these bacteria are rapidly killed at the temperature which frozen orange concentrate is stored.[5]

When the bacteria count reaches a specified number, the plant is completely shut-down and all the equipment is given a very thorough cleaning. This type of cleanup usually occurs once a week. With these strict sanitation regulations and plant cleanups, the production standard for frozen orange concentrate is held at a high level.

## Quality

The quality control program of any concentrate plant is designed as insurance that a good product is continuously being produced. What are some of these checkpoints in securing an excellent preserved quality in orange concentrate? First of all, mature fruit must be used by the plant. Here is one of the most important checkpoints, that of checking

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5. Faville, L. W., E. C. Hill, and E. C. Parish. Survival of Microorganisms in Concentrated Orange Juice. Food Technology. Volume 5, Number 1, 1951, p. 34.

the maturity of incoming fruit. Another very important quality control step is that of blending the concentrate juice with the "cutback" juice. Sanitation, previously mentioned, is another quality checkpoint that must be continuously supervised by the laboratory technicians. In the extraction of juice from oranges, the peel oil content of the juice must be below .03 percent to avoid a bitter taste in the juice. The vitamin C content of the juice must be maintained above forty milligrams per one hundred grams of juice if the nutritional value of the concentrate is to be maintained. These are some of the major considerations that must be kept under close observation and control if the finished product is to be accepted by the consumer as a good quality of preserved orange juice. These problems do not appear to be very great, but on a large scale production line, these quality control measures are magnified into situations that are major production problems.

It is appropriate in this section on quality to point out an advantage that orange concentrate has over fresh oranges. As was previously stated, oranges do not continue to ripen after they are picked. Consequently, the consumer buys fresh oranges at whatever period of maturity they were when picked. Through the process of blending, orange concentrate is always at its best from a maturity and quality standpoint, whereas one fresh orange might be delicious and the next one sour. This also gives the processed orange juice a distinct advantage over fresh fruit because oranges can not all be picked at exactly the right moment of ripeness.

In the processed form of orange concentrate, orange juice can be blended so that over mature fruit can be mixed with less mature fruit. This provides a better juice than is present in the over and less mature fresh oranges. What is meant by this, is that oranges with low solids contents (around nine) can be blended with oranges of high solids (approximately nineteen) to produce a juice that contains the right amount of solids. Most concentrate plants want their finished product to have a solids content of approximately twelve.

This blending process is especially useful when the seasonal change in varieties takes place, when one variety is generally too ripe at the end of its season and the incoming variety is not as mature as it should be. This provides for a more efficient use of the orange crop, as well as giving the consumer a better product.

## Nutritional Value

Frozen orange concentrate is a reliable source of vitamin C when fruit of high nutritive quality is used in processing. Only a very small percent of this original vitamin C content is lost in processing the juice.[6] It has been proved by tests that approximately 98 percent of the vitamin C content is retained in the concentrated product. However, this is only true on properly processed and refrigerated concentrate. Temperature plays a very important part in retaining the nutritive value in orange concentrate.[7]

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6. American Medical Association. Frozen Concentrated Orange Juice. Reprinted by Special Permission from, The Journal of the American Medical Association by Birds-Eye Division, General Foods Corporation.

7. Roy, Wallace R. Retention of Vitamin C in Concentrated Quick-Frozen Orange Juice. Food Industries. Volume 20 (December 1948), p. 110.

There is a danger that the vitamin C content might be lost from the juice by improper handling and storage in the home. This is where consumer education is a very necessary and vital part of insuring the quality of the product until it is consumed. A good quality product is of no value to the consumer if they unknowingly destroy its nutritive value just prior to consuming it. Ideally, the juice should be consumed as soon as possible after reconstituting it with water to obtain the maximum vitamin C value. However, if the reconstituted juice is placed in the refrigerator at forty degrees Fahrenheit, the vitamin C loss is small.[8]

The vitamin C content varies with different varieties of oranges. This is due in part to seasonal influences. Fruit that is picked in the middle of the season for a specific variety is higher in vitamin C content than fruit picked early or late in the season. Other factors, including the variety of fruit, degree of ripeness and condition of the soil, effect the vitamin C content.

Orange juice contains, in addition to its high amount of vitamin C and P, quantities of vitamin $B_1$, $B_2$, niacin, pantothenic acid, pyridoxin, biotin, inositol, folic acid, and vitamin A. It also has a fair amount of calcium, potash, and phosphate. From two to six ounces of reconstituted orange concentrate per day will fulfill all of the normal requirements for vitamin C in the body.[9]

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8. Roy, Wallace R. The Nutritional Value of Frozen Concentrated Orange Juice. Phamphlet from, Minute Maid Corporation, Plymouth, Florida. p. 2.

9. Roy, W. R. Ibid. p. 2.

The production of frozen orange concentrate is a very technical process that requires close supervision in its many phases of production. It gives the consumers a good quality of orange juice on a year round basis. It is easy and convenient to prepare. There is no mess and bother with squeezing enough oranges to provide juice for the entire family. It also provides orange juice of comparable quality to that of fresh oranges in out-of-the-way places that do not have a readily available supply of fresh fruit. The advent and production of orange concentrate gives orange juice a more universal appeal in that it can be sold wherever adequate refrigeration facilities are present.

# CHAPTER V

## TRANSPORTING

Because of its compactness orange concentrate does reduce shipping cost from the standpoint of the amount of weight to be shipped. The average-sized can is six-ounces and is packed forty-eight to a case. This case weighs approximately twenty-eight pounds. This small twenty-eight pound case is replacing approximately two boxes of fresh fruit, a considerable saving in weight and space. To emphasize this point, it would take approximately sixty cars of fresh fruit with an average of 500 boxes per car to equal the amount of concentrated orange juice in six refrigerated carloads.

### Temperature

Quick-frozen orange concentrate must be transported at very low temperatures. This was an extremely difficult task not so many years ago. For any type of equipment to be able to transport frozen orange concentrate safely, it should be able to keep a temperature of zero degrees Fahrenheit, which adds considerable cost to the transporting operation.

One concentrate firm specified that they would not ship in units that did not have six inches of insulation, because if the temperature of the shipment is allowed to increase while in transit, it seldom regains the desired temperature when stored in the warehouse. The purpose of the

cold storage warehouse is to have zero degree temperature or colder, but not to maintain quick freezing equipment. Also, if the temperature increases, it would allow the nutritional value of the concentrate to be damaged. Therefore, it is important that the proper temperature be maintained while the product is in transit.

Because of the long distance that orange concentrate must be shipped, refrigeration is a very important factor. California and Florida are both far from some of the large central markets. Up to this time, truckers have taken the initiative in supplying units that would give a satisfactory temperature during transit. With the advent of the mechanically refrigerated type of railroad car, the railroad companies have taken a step in the right direction to insure safe temperatures for frozen food products.

Another requirement that is necessary in these transportation units is the use of wall and floor racks. The purpose of this is to keep the cases of concentrate off the floor and away from the wall to allow for the proper circulation of the cold air. No temperature, however low, can protect cases stacked flat against smooth walls and floors.[1] Another requirement is that all railroad cars and semi-trailers should be pre-cooled before loading. If proper pre-cooling is practiced there should only be a small temperature increase when the cases of orange concentrate are loaded into the transportation unit. All the effort that goes into

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1. Anonymous. Temperature Problems in the Concentrate Industry. Minute Maid Corporation. Plymouth, Florida, 1950. p. 5.

producing a good quality concentrate will be wasted unless proper temperatures are maintained during transit. Safe, low-cost transportation of orange concentrate is one of the major problems facing the industry today. This problem is common to all types of frozen food products which can be damaged by high temperatures.

## Rail Facilities

At the present time, there are approximately 25,000 insulated refrigerated cars in the United States, which the railroads claim are suitable for handling frozen food shipments. However, this is a very misleading statement. This figure covers cars that have only three or four inches of insulation, which is not enough to protect frozen foods, especially orange concentrate, from high temperatures. It has been estimated that only one out of ten of these refrigerated cars are insulated enough to maintain a zero temperature.[2] A heavily insulated car should have at least six inches of insulation in the roof, sides, ends, and floor. Table III shows the number of these heavily insulated refrigerated cars available in 1947, 1948, and 1949.

This was the situation several years ago, and it was a major problem for most frozen food firms. When the frozen food industry first began to ship its products by rail, they soon realized that the standard refrigerated car with only two or three inches of insulation did not provide adequate protection of the product while in transit. Most companies were induced to add more insulation to their cars, but for the majority of shippers, the old standard refrigerated cars were all that were available.

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2. Anonymous. Frozen Food Factbook. New York: National Wholesale Frozen Food Distributors, Inc., 1952, p. 71.

TABLE III

APPROXIMATE NUMBER OF HEAVILY INSULATED RAILROAD CARS AVAILABLE IN 1947, 1948, AND 1949[3]

| Car or Company Initials | 1947 | 1948 | 1949 |
|---|---|---|---|
| AMRX | 25 | 25 | 25 |
| ART | 25 | 22 | 22 |
| BRE | 30 | 30 | 29 |
| FOBX | 49 | 59 | 75 |
| FGE | 73 | 72 | 170 |
| LFE | 101 | 101 | 100 |
| GARX | 85 | 63 | 63 |
| MDT | 9 | 5 | 5 |
| NRC | 47 | 49 | 48 |
| NHIX | 50 | 100 | 99 |
| NWX | 55 | 64 | 64 |
| NADX | 226 | 226 | 226 |
| PFE | 413 | 410 | 404 |
| SFRD | 244 | 244 | 243 |
| VRT | 361 | 383 | 383 |
| Total | 1795 | 1853 | 1956 |

3. Source: Anonymous. Frozen Food Factbook. New York: National Wholesale Frozen Food Distributors, Inc., 1952, p. 43.

The rapid growth of the orange concentrate and the frozen food industry in general after World War II was part of the reason why there was not enough suitable equipment for low temperature transportation. Also, besides the heavy demands placed on the railroads during this time, there was a shortage of railway cars, which had developed during the critical shortage of available materials for construction purposes during World War II. This forced the frozen food shippers to use the same type of car that was used for fresh perishable food products. These lightly insulated cars with end bunkers were kept as cold as possible with coarse ice and the addition of 30 percent salt. These cars were not satisfactory for frozen food shipments and led to the construction of cars with heavier insulation. Some of the new cars were equipped with top bunkers instead of end bunkers for icing.[4] The top icers are different from the end bunkers in that they have a series of hatches on the top of the car. Most of these top icers are equipped with ten overhead tanks, each tank having a capacity of 900 pounds of crushed ice. This compares with the heavily insulated end bunker cars which have a capacity of approximately 10,800 pounds of coarse ice. The heavily insulated top icers are more suitable for frozen food shipments than the end bunker types. However, there are not many of these cars available for use by the frozen food industry. On the other hand, there are about 20,000 cars of the end bunker type available for use now.[5]

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4. Ibid. p. 53.

5. Larson, J. S., J. A. Mixon, and E. C. Stokes. Marketing Frozen Foods. United States Department of Agriculture, Production and Marketing Administration, Washington, June 1946, p. 45.

The standard refrigerated car with three and a half inches of insulation is not as large as the heavily insulated cars and has an average ice capacity of 10,000 pounds. This type of car, is equipped with fans and can be used for very short hauls, providing there are no long delays in transit.

In refrigerated cars that are iced, 30 percent salt is added. For every one hundred pounds of ice, thirty pounds of salt are added to keep the car as cold as possible. With the addition of 30 percent salt, the standard refrigeration charges are increased approximately 50 percent, which makes it rather expensive to ship frozen foods.[6]

On a transcontinental run by rail approximately 36,000 pounds of ice and 10,800 pounds of salt are used per car at a cost of $224.00. This same run with a car containing two mechanical refrigeration units used 218 gallons of fuel at a cost of $52.00.[7] This statement gives some indication of the difference in cost between ice and mechanical refrigeration. Taking into consideration the fact that the mechanical units cost more, this expense could be made up by reduced refrigeration costs and time lost in switching cars to an icing station. The railroads have brought out several models of mechanical refrigeration units that have proved very successful, but as yet, there are not enough of them to serve the frozen food industry.

At present, the railroads have two different types of mechanical refrigerated cars. One has a Thermo King refrigeration unit which

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6. Ibid. p. 46.

7. Frozen Food Factbook. Op. cit. p. 55.

operates from a four-cylinder gasoline engine. Two of these units are mounted in one end of the car in a compartment with the width of two normal ice bunkers. The other type of refrigeration unit is made by Frigidaire and is diesel-powered. This unit is contained in one end of the car and fuel is carried in a 240 gallon tank underneath the car. Both of these mechanical refrigerated cars are forty feet long and have six inches of insulation.[8]

These mechanical units are able to keep the desired constant temperature that frozen orange concentrate requires while in transit. An advantage of this type of car is that it can bring the car temperature back to zero degrees after it has been loaded. All cars that carry frozen food and frozen orange concentrate are pre-cooled before loading but lose part of this coldness when they are loaded. If the railroads can supply enough of these types of cars to frozen food shippers, they will have taken a step towards recovering the frozen food traffic which they have been steadily losing to trucking companies.

## Truck Facilities

In the early days of frozen food shipments, trucks were used only for short hauls. The first trucks only had from two to four inches of insulation and were refrigerated by barrels of wet ice and salt. Gradually, trucks with six inches of insulation were put into operation.

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8. Redit, W. H., H. D. Johnson, J. D. Hall, R. Cubbedge and J. Kaufman. Transportation of Frozen Citrus Concentrate By Railroad and Motor-truck From Florida to Northern Markets. United States Department of Agriculture, Washington, Agricultural Information Bulletin No. 62, p. 3.

These trucks were kept cold with dry ice on the top of the load or in bunkers in the top of the truck. Today, trucks have mechanical refrigeration units that do a very efficient job of holding zero temperatures. In many cases, trucks were able to attain lower temperatures than railway cars because trucking firms could modernize their equipment much faster and at less cost.[9]

Trucks have made considerable gains in the frozen food transportation field at the expense of the railroad. This growth can be attributed to several reasons:[10]

1. They are speedier on most hauls, particularly on short overnight hauls between nearby cities.

2. They reduce extra handling and are able to transport to areas where rail facilities are lacking. This is a great advantage to receivers that do not have rail sidings.

3. Frequently, they are capable of maintaining more desirable temperatures. The increase in the number of properly refrigerated trailers has been much greater than that of railway cars.

4. Generally, they are much more economical on short hauls.

5. Trailer trucks are a much more flexible means of transportation. This type of operation is indispensable in supplying points that need less than carload shipments.

The majority of trailers that haul long distance shipments of orange concentrate have mechanical refrigeration units. However, many refrigerated trucks are constructed for cooler temperatures only and are not suitable for transporting frozen commodities. The biggest

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9. Frozen Food Factbook. Op. cit. p. 55.

10. Larson, Mixon, Stokes. Op. cit. p. 52.

difficulty with the mechanical refrigerated systems in trucks is that moving parts are subject to breakdown and repair. Recent changes in the arrangement and construction of the refrigeration systems on trucks have corrected this situation somewhat.

Truck transportation companies have a serious disadvantage on long haul shipments. The lack of uniform state road-weight laws is the cause of this handicap. These laws vary from 42,000 pounds in Kentucky, Missouri, and Tennessee to 60,000 pounds in New Jersey for a single axle tractor. Semi-trailers, taking into consideration the height and length of the trailer, vary from 42,000 pounds in Kentucky to 80,000 pounds in West Virginia.[11]

The trucking industry has done much to provide the proper type of equipment that is necessary in transporting frozen orange concentrate as well as frozen foods.

## Rail Versus Truck

In one particular warehouse in Chicago the incoming shipments of frozen orange concentrate are 13 percent by rail and 87 percent by truck. This is not meant to be taken as an over-all average, but it does indicate that trucks are transporting more frozen concentrate to a central market such as Chicago.

In comparing the use of trucks and rail facilities for the shipment of frozen orange concentrate, one of the first considerations would probably be load size. A truck can haul, subject to different weight

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11. Frozen Food Factbook. Op. cit. p. 55.

regulations by individual states, from 1,000 to 1,200 cases of orange concentrate. This compares with 2,000 to 2,500 cases for a normal railroad car and approximately 4,500 cases in the new type of refrigerated car. The size of the shipment could definitely be a deciding factor. If the shipment is going to a large warehouse that can handle a carload of orange concentrate, the railway car would probably be given preference. However, a good many shipments are to frozen food distributors and food chains that do not have a large enough volume to handle a carload shipment which is twice the size of a truck shipment. This is where trucks have a decided advantage over the railroads.

Another advantage of trucks is that they have more equipment that provides proper temperature control available to shippers than do the railroads. However, the new type of railroad car can hold an equally low temperature to that of a truck. There is a definite shortage of mechanically refrigerated railroad cars at the present time and its use is limited to a few shippers.

Trucks have the advantage over rail shipments in that they are very flexible. They are not limited in their area of operation as are the railroads. Since many of the customers in this new frozen food field do not have any rail facilities at their plant or warehouse, trucks are given the job of transporting orange concentrate to these distributors.

An advantage that railway cars have over trucks is that they are generally loaded through a canvas tunnel that permits cold air from the cold storage warehouse to enter the car. This lessens the possibility

of a temperature drop in the railway car as well as in the product. In general, no protective covering of this nature is provided for trucks. This is not the fault of the trucking firms, but of the orange concentrate plants, which have not provided proper loading docks for them.

Truck transportation is much faster than rail delivery. This is especially true on short hauls of 500 miles. The new type of mechanically refrigerated rail cars will help to remove this large difference in delivery time because they do not have to be switched into re-icing stations every twenty-four hours, which is time consuming.

Some of the larger concentrate companies prefer to use rail shipments to send their product to centrally located warehouses in specific regions. In this way, they are able to ship larger shipments to the warehouse, who then break down the shipment into smaller lots for re-shipment to individual distributors. Minute Maid has one hundred of these regional or centrally located warehouses that supply the needs of the distributors in that particular area.

## Handling

The cases of frozen concentrate are stored in the cold storage room on "floats" or pallets. These pallets are so constructed that they can be moved around by a small fork-lift truck. These small trucks operate from giant size batteries which work very efficiently in the low temperatures of the cold storage room. Cases are stacked on the pallets in an open pattern that permits complete circulation of air around each case. The temperature of these cold storage rooms is between minus

fifteen and minus ten degrees Fahrenheit for most concentrate plants. The cases of concentrate generally remain at this point for one week, at least, to be sure that the product does not have a chance to thaw-out immediately after processing.

In loading both trucks and railway cars, conveyors equipped with rollers that allow the cases to slide along the conveyor are used. In rail shipments, these conveyors are placed inside canvas tunnels to minimize the loss of cold air. This practice is not followed in loading trucks where both rear doors are open for loading. It usually takes approximately an hour to load a semi-trailered truck, which allows the loss of coldness already obtained in the trailer from pre-cooling. A tunnel between the trailer and storage room or a canvas curtain over the doorway of the trailer would minimize the loss of temperature.

This same problem is encountered in the unloading operations where the cases are often unloaded at a considerable distance from the warehouse cold room. There is a definite need for better loading and unloading facilities for both rail and truck shipments. Frozen food, and especially frozen orange concentrate, needs careful handling to insure the consumer of getting the quality of product that is sealed in the package or can. The transportation industry has done a lot to improve the quality of their refrigeration units to meet the demands of this relatively new industry. However, much attention needs to be directed to the loading and unloading operations, so that the efforts of good production practices and improved transportation facilities are not in vain.

# CHAPTER VI

## MARKETING

The marketing of frozen orange concentrate follows very closely the pattern set by the frozen foods industry as a whole. Frozen food distribution is an example of a young industry that has grown up too fast, stumbling along as it learns to operate in a highly competitive field of food marketing. In a way, it grew up so fast that it had not learned to crawl before it was walking with established methods of marketing. This rapid transition caused many hard falls and serious setbacks to the industry. When one considers that the normal established patterns of marketing procedure were absent, it is remarkable that the frozen food industry has shown the success it has in marketing a new product.

Not only was the product new, but the methods of marketing were different and untried. Most new products have their future acceptance smoothed over with the best marketing methods available. This was not true in the marketing of frozen orange concentrate. There were as many problems to face in its marketing procedure as there were in its inception and commercial production. This product did not fit into the regular channels of distribution because it needed special handling and facilities. Not only did this new product need refrigeration, but it needed a special form of low temperature refrigeration. These facilities

had to be developed and expanded at the same time that a new product was placed before the public for consumer acceptance.

In general, one might say that the frozen food industry started operations in a state of over-all confusion. Production techniques were not standardized, nor were grades. Some producers put a fine quality product on the market while others were continually undermining the product's consumer acceptance with inferior packs. However, orange concentrate made a rapid accent into the acceptable consumer products' group despite these disadvantages.

Besides facing untried marketing methods and thoroughly inadequate transportation and warehouse facilities, few retail outlets had display cases that could properly handle the product. This was one of the most difficult problems confronted by the industry. How could it place orange concentrate before its potential customers in the retail outlets? Store owners and managers were not going to invest a sizable sum of money in refrigerated display equipment to sell the new untested products of the frozen food industry. This problem was further magnified by the fact that the few refrigerated display cabinets on the market in 1945 were not very acceptable. New cabinets were developed that could maintain the desired temperature and give the consumer a view of the product, but not until frozen food sales were virtually bottlenecked by the lack of this equipment.

Various food store fixture companies were quick to supply the need for this form of display cases. Much credit for frozen foods' rapid rise in popularity can be given to these companies that provided a way for it to be retailed properly.

Then came the problem of the customers themselves. The frozen food products sold themselves on the waste they eliminated and the quality they preserved, but how could the would-be consumers use this product, unless they had the required refrigeration temperature in their own home or they made a trip to the grocery store just before meal time? It is very easy to see what some of these seemingly unsurmountable problems were that this new industry faced.

Table IV shows the amount of frozen food capacity that is available in the home cabinets of consumers in relation to the production of frozen foods. The frozen food production figures given are for all frozen fruits and vegetables packed in retail containers during the specified years. The capacity of home freezers are figured in pounds and are for freezers not more than five years old. These figures show that it was not until 1950 that home freezer capacity exceeded that of the retailed packaged form of frozen foods. This gives evidence to the serious handicap the frozen food industry had in first merchandising their products for home consumption.

Orange concentrate, as well as frozen foods, probably had successful results earlier with the institutional trade. These users were better equipped with more satisfactory refrigeration facilities at the beginning to handle this new product. Also, the labor saving value of frozen foods was more apparent to them and meant dollars and cents savings in operational cost. These users were not the main market objectives of the industry, but they helped provide the industry with a secure footing until further retail sales could be obtained from millions

TABLE IV

PRODUCTION OF FROZEN FRUITS AND VEGETABLES COMPARED WITH FREEZER CAPACITY OF HOME CABINETS[1]

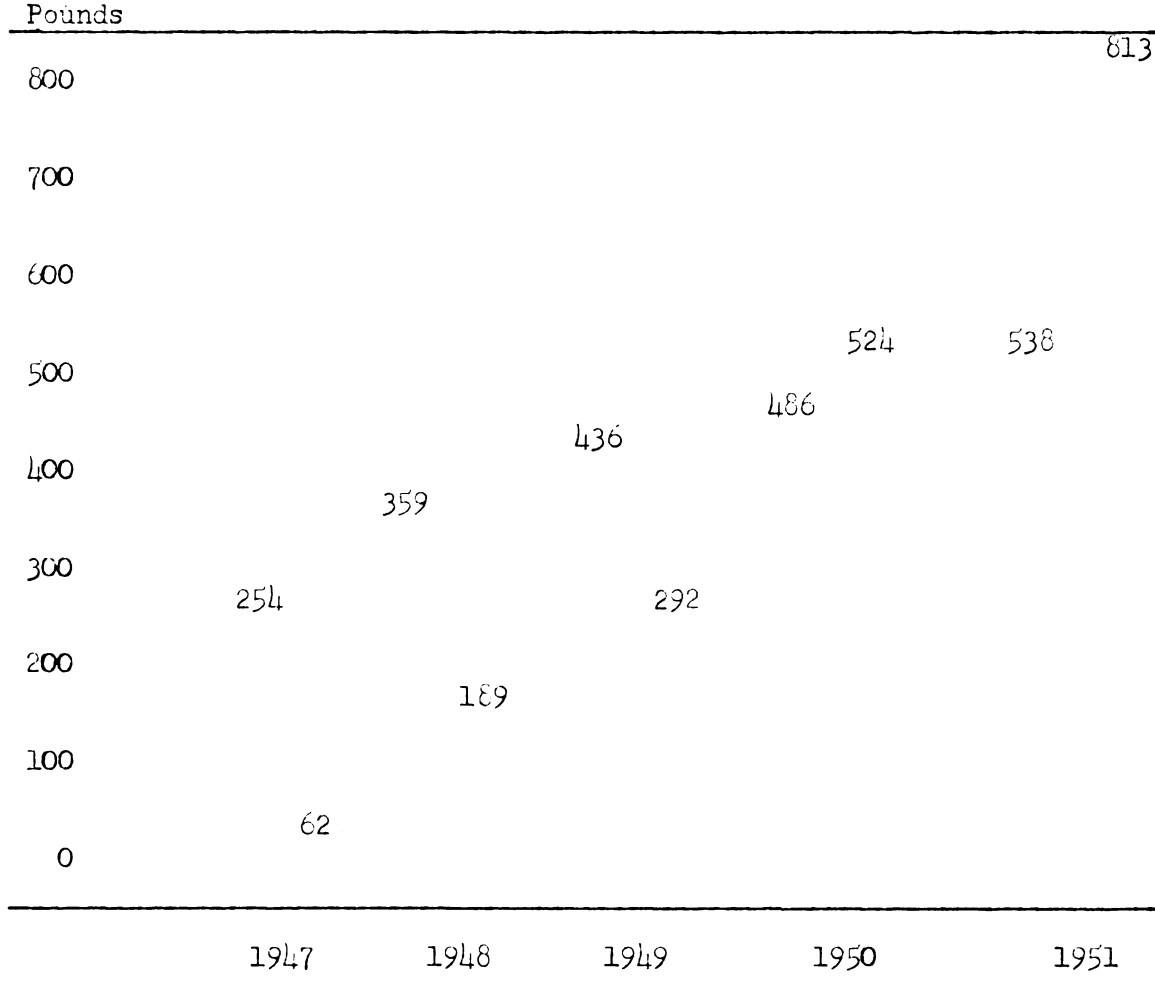


Figure on left for each year is frozen food production.
Figure on right for each year is for home freezer capacity.

1. Anonymous. Frozen Food Factbook. New York: National Wholesale Frozen Food Distributors, Inc., 1952, p. 113.

of potential customers. In 1952, it was estimated that the retail trade was only 20 percent developed, compared with 75 percent in the institutional field. These figures apply only to the number of outlets for frozen foods, not to the volume saturation, which is undoubtedly less than 50 percent for frozen foods and around 20 percent for frozen orange concentrate.[2]

The necessary investment in equipment for the marketing of frozen food has been high. Frozen foods, however, have been well adapted to a recent innovation in food merchandising. Self-service requires packages and containers that are adaptable to this method of operation. Frozen food with proper display cases has fitted into this form of merchandising with great success. Probably a great deal of the success of frozen food sales in such a short period of time can be attributed to this technique of merchandising.

This brief introduction into some of the industry's problems of standards, equipment, and marketing procedures shows why the lack of organization of the industry prevents it from making a unified effort to operate. Many of these problems have been solved, some only temporarily, because the industry is still growing.

## Channels of Distribution

In following the channels of distribution of frozen orange concentrate, the warehouse of the producer is where the marketing of the

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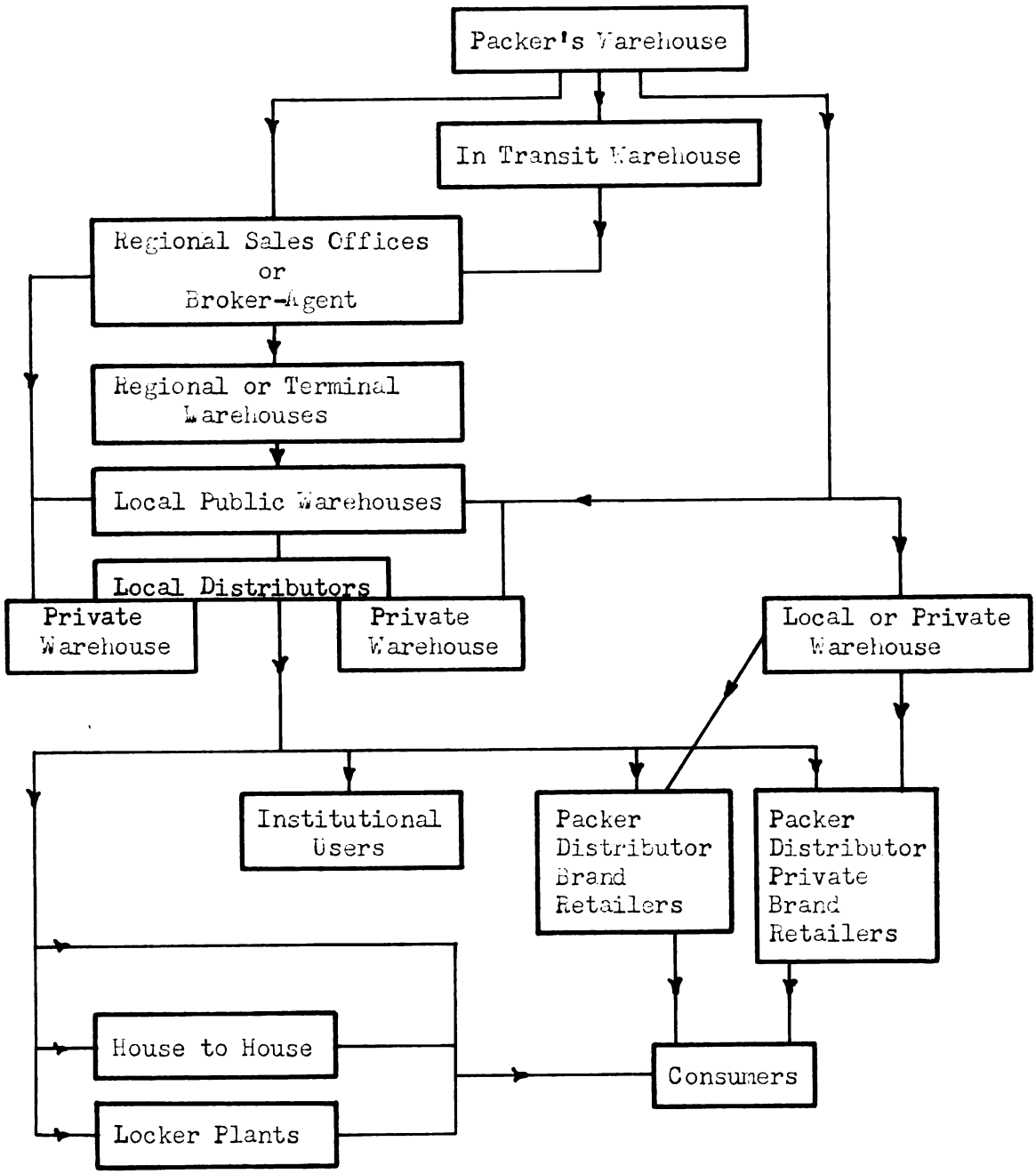
2. Fitzgerald, Gerald A. Frozen Food Distribution. Food Industries. Volume 22 (September 1950), pp. 65-69.

product begins. All concentrate plants have their own cold storage rooms. Some of these refrigerated warehouses are really large--one of the largest in Florida holds three million cases of orange concentrate.

The chart that shows the lines of distribution on the following page will be explained below. As the lines in this chart indicate, all shipments originate from the producer's warehouse. This includes the large industry leaders as well as small independent or cooperative plants. Because the production of orange concentrate is so fast, some firms that lack sufficient warehouse space move shipments of orange concentrate in the general market direction. These shipments are stored in cold storage warehouses, which are classified as in transit warehouses in the chart. This method of operation reduces the amount of operational capital needed, because only part of the shipping charges are paid. These shipments are classified under in transit shipping regulations. An example of this would be, for direct shipment to Omaha, Nebraska, the shipping charges are approximately sixty cents per case from Florida. If 1,000 cases were shipped and placed in storage there, the freight bill would be $600.00. However, if the same shipment was only sent on its first leg to market, say to Atlanta, Georgia, the freight would be approximately ten cents per case or a total of $100.00, which makes a difference of $500.00 in prepaid freight on this shipment. In large industry wide operations, this can become an enormous figure. However, some shipments are sent directly to the terminal markets or to local destination consignees. It is only on shipments that do not have an immediate market that are shipped in transit.

Figure 1.

CHANNELS OF DISTRIBUTION FOR ORANGE CONCENTRATE



Large shipments of orange concentrate are sent to regional or terminal cold storage warehouses in big metropolitan centers. This space is usually obtained on a rental basis. The regional sales representatives of the producers who have their own marketing organizations are located here. If the company does not have its own salesmen, a food broker, acting as their agent, represents them.

These terminal warehouses have a large stock of frozen concentrate. In this way, they can receive large shipments of concentrate from the distant producing areas and have a ready supply for the nearby markets. Shipments are then made to local distributors or local warehouses where the distributor has refrigerated space. The regional sales office and brokers act as the producer's sales office in that region. They do not have actual physical possession of the product. The service they perform is more of a coordination of ordering and selling the product to local distributors and large food chains. There is a trend for the large food retailers to by-pass the local distributor in purchasing orange concentrate as well as frozen food.

The warehousing operation in terminal markets is a rather expensive stop. The basis for charges by most cold storage warehouses is approximately this; The first month's charges for handling and storage is thirty-five cents per hundred weight. The second month's charges for storage are approximately fifteen cents per hundred weight. These charges are not proportional over the month. If the merchandise stays in the warehouse only one day, it is still billed for a month. These facts have led most firms to reduce their inventories as much as possible.

Minute Maid has a policy of storing less than a sixty day supply in these terminal warehouses. They have at their disposal in this country, one hundred such terminal warehouse facilities, which are located in major cities. Generally, this space is rented from warehouse companies.

These big terminal warehouses carry the necessary inventory for local distributors and other buyers who can not afford to handle large shipments. These warehouses provide an immediate source of supply for buyers within their area. The reason for these large centrally located warehouses is to stabilize the marketing of orange concentrate. Their presence provides the necessary inventory for small buyers to draw on and receive rapid delivery. This cuts down the inventory stock that the local distributor and other large buyers, such as food retailers, have to carry in their own warehouses. This is good for all concerned, because the local distributor and other large quantity buyers are not out to speculate on the price of orange concentrate, which would be the case if they were required to buy enough orange concentrate that would last them for several months. These local distributors are operating for a business profit, not a speculative profit in inventories. In most cases, they would not have the capital to invest in such an operation, which is also expensive from the standpoint of refrigerated warehouse charges. Also, it provides for small dealers who are located near the terminal markets and do not have local or private warehouse facilities.

Next down the line of distribution comes the local warehouse. In many cases, direct shipments are made to local warehouses straight from the concentrate plant. Local distributors often have rented space

in these local warehouses and operate from them. Refrigeration in warehouses is an expensive item. It was estimated in 1950 that 500,000,000 cubic feet of gross warehouse space had been made available for frozen foods. This approximately indicates an investment of $250,000,000 for this available warehouse space.[3] It is no wonder that few local frozen food distributors have their own refrigerated warehouses.

These local distributors can be specialized in their operations. Some have only retail customers and others specialize in institutional users. However, there are local distributors who perform both types of operations. All this depends a great deal on the size of the market that is served.

Most local frozen food distributors operate from two basic plans. One method is used when a driver-salesman calls on the customers, takes the orders, and delivers the merchandise at the same time. The other method is used when an advance salesman calls and takes the order, which is delivered at a later date by a delivery truck. This second method was probably used more at the beginning of frozen food distribution because of the shortage of refrigerated delivery trucks. However, the trend is towards the first method of driver-salesman, which is the method used in other food distribution fields in serving the retailers and some institutional users.

There are certain advantages and disadvantages for both methods. In the advanced sales method, the route mileage of the delivery truck

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3. Ibid. p. 66.

is liable to be less than that of the driver-salesman's truck because no stops are made except when deliveries are to be made. However, the delivery truck for the advance salesman might not operate efficiently at a full load because of deliveries made to certain customers on different days of the week. The driver-salesman system has the advantage of enabling the driver to increase the size of the delivery to those customers who make unexpected demands. Adequate equipment must be used in the case of the driver-salesman. If sales and deliveries are less than expected, the delivery truck used by the driver-salesman must be able to maintain a low enough temperature to insure the frozen food from rising more than five degrees Fahrenheit when it is finally brought back to the plant.[4]

Modified ice cream trucks have proven fairly successful in frozen food distribution. There are several methods of refrigerating delivery trucks: dry ice, mechanical refrigeration units, and cold-hold plates. The cold-hold plates must be refrozen each night when the truck returns to the warehouse. This can be done by connecting the plates to the warehouse's refrigeration lines.

Some of the larger food chains order their needs of frozen orange concentrate directly from the packer. This is especially true of private label brands of orange concentrate. However, some packer brands are brought directly from the packer and from the terminal warehouses in the central market areas.

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4. Anonymous. Ice Cream Trucks Serve In Frozen Food Distribution. Food Industries. Volume 20 (May 1948), pp. 114-115.

In the case of one large food chain, the buyers order orange concentrate directly from the packer and terminal warehouse and employ a frozen food distributor to make regular deliveries for them at a fixed cost. In this system, the retail store phones the chain's branch headquarters, which fills out the order form and sends it to the frozen food distributor who delivers the orders to the retail stores from the chain's inventory of orange concentrate. The fixed price of delivery is usually figured on a per case basis and orders and deliveries are handled in case lots, eliminating the service of a salesman calling at the stores and reducing selling cost.

There is some orange concentrate and frozen foods sold by locker plants and house to house distributors. This form of distribution is very small for orange concentrate. Too many companies entered the home delivery field right after World War II and were competing for space in too few home-owned freezer cabinets. The idea of home deliveries has its merits, but because of the lack of home freezers and the high cost of this service in relation to the sales volume, the system did not work well. In fifty cities in the United States surveyed by the United States Department of Agriculture in 1949, only eighteen cities had house delivery services of any consequence. In most cases the home delivery services were operated in conjunction with home freezer sales.[5]

The cost of frozen food distribution is high. The main reason for this is the necessity of merchandising and handling the items in the

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5. Larsen, J. S., J. A. Mixon, and E. C. Stokes. Marketing Frozen Foods. United States Department of Agriculture, Production and Marketing Administration, Washington, June 1946, p. 125.

frozen state. Keeping frozen food products under low temperature refrigeration during the many months they are stored or on their way to market is a costly process. Cheaper means of refrigeration and less re-handling of the shipments are necessary in the future if the cost of frozen foods and its distribution are to be reduced.

## Retail Sales

It has been estimated that 56 percent of commercial frozen foods reach the consumer through retail outlets. The other 44 percent reaches the consumer through institutional and other outlets. This estimation was made in 1949.[6] Of the 56 percent going to the consumers in the retail-size packages, the majority of it is marketed through retail food stores. There is only a very small percentage marketed through locker plants and house to house selling organizations.

In the retail field, the bottleneck has been in the refrigerated display cabinets that could maintain a proper level of temperature and yet display the merchandise. Retailers have been induced to buy display cabinets on a long term basis, rent, or even permit the local distributor to supply him with a cabinet. There are all kinds of arrangements between the retailers and the frozen food distributor, some who are also in the appliance business, on the installation of frozen food display cases.

On the basis of a nationwide sample of retail stores by the United States Department of Agriculture in August 1950, it was estimated that approximately two out of every five retail food stores had frozen

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6. Ibid. p. 123.

concentrated orange juice in their stores. This compares with about one out of every four for August of 1949. This availability of frozen orange concentrate is in food chains and large independent food stores that can afford to invest in display cabinets. It has also been estimated that frozen concentrates are more widely distributed in medium-sized and large cities, rather than in towns of less than 10,000 population.[7]

In determining the type of retail outlets where frozen orange concentrate is sold, information has been tabulated on independents, national chains, regional chains, and other outlets. These surveys were conducted by the National Consumer Panel of Industrial Surveys Company for the United States Department of Agriculture, starting in 1949.[8]

The definition of "national chain" includes only the three largest national food chains in this survey. "Regional chains" denotes other companies having four or more retail food stores under a common management. The term "independent" is used to describe food stores of the unaffiliated type. "Other outlets" is a grouping of such outlets as delicatessen, fruit stands, speciality stores, and other stores having food departments.

To summarize some of their findings, regional chains are the leading outlet for frozen orange concentrate. From October of 1949 through

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7. Johnson, D. B. Marketing Frozen Concentrated Orange Juice. The Marketing and Transportation Situation, United States Department of Agriculture, Washington, Series MTS-91, December 1950, pp. 6-12.

8. U. S. Bureau of Agricultural Economics. Consumer Fruit and Juice Purchases July-September 1951, United States Department of Agriculture, Washington, December 1951, p. 12.

September of 1950, they sold just under five and a half million gallons of concentrate. In the following period from October, 1950, through September, 1951, they increased this figure to almost nine million gallons.

The independent and national chains are almost equal in the amount of orange concentrate sold. From October, 1949, through September, 1950, the independent outlets sold approximately five million gallons of orange concentrate. This compares with the following year of sales, which was six and one-half million gallons. The national chains sold approximately four and a half million gallons from October, 1949, through September, 1950. In the following year, sales had increased to approximately six and a half million gallons of orange concentrate.

Other outlets share only a very small percent of the retail market. Their sales figures for both years were around three-fourth of a million gallons. These increases show that sales are very high in stores that are equipped to handle and display concentrated orange juice properly, and that it is increasing with the availability of store display cabinets and freezers in the consumers' homes.

The average percentage of frozen food sales in the retail food stores is around 4 to 5 percent of total sales. This figure is only an average figure and does not reveal those stores that are below and above this figure.[9]

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9. Frozen Food Factbook. Op. cit. p. 73.

The price spread from what the consumers pay for frozen orange concentrate and the price of the oranges to the processor was between seventeen and nineteen cents per six-ounce can for six large cities in the first six months of 1950. These cities that were surveyed by the United States Department of Agriculture were Boston, Chicago, Cleveland, New York, Pittsburgh, and St. Louis. These marketing charges cover all costs of production, wholesaling and retailing, advertising, and transportation, as well as profits.[10]

This can be compared with canned single-strength orange juice, whose marketing charges averaged for the same period, approximately eleven to twelve cents for a number two can. There is twenty-four ounces to a six-ounce can of orange concentrate when it is reconstituted, and only eighteen ounces in a number two can which makes a slight difference for comparison. However, a number two can with eighteen ounces is three-fourths of the twenty-four ounces obtained from the six-ounce can of orange concentrate. Thus in comparing equal amounts of each, single-strength orange juice runs twelve cents in comparison to fourteen cents in price spread for an equal amount of orange concentrate. Frozen orange concentrate is still a more costly form of orange juice than the single-strength canned juice. These higher costs are reflected in the higher charges for transportation and refrigerated warehousing for frozen orange concentrate.

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10. Parr, Kathryn. Retail Cost and Price Spread for Frozen Concentrated and Single-Strength Orange Juice. The Marketing and Transportation Situation. United States Department of Agriculture, Washington, Series MTS-91, December 1950, pp. 13-16.

Frozen foods are here to stay, and so is frozen orange concentrate. Beginning January of 1951, three important frozen foods--strawberries, orange concentrate, and peas were added to the regular monthly government index of food prices, because they had become too important an item to overlook in modern family spending. Thus a better method of satisfying consumer wants will always succeed. Now it is up to the industry to reduce some of the high distribution costs that keep the retail price of frozen foods above similar items processed and preserved by other methods.

# CHAPTER VII

## SUMMARY

The record of growth made by the processors and distributors of frozen orange concentrate since the end of World War II can be matched by few industries. When frozen concentrate was first manufactured on a commercial scale in the 1945-46 season, the output for that twelve month period was 226,000 gallons, and it consumed only one-fifth of one percent of the oranges grown in the United States. In the 1948-49 season, this had increased to over twelve million gallons, and if it had been stacked in one place, it would have made a golden glacier sixty feet wide, five feet deep, and one mile long.[1]

The 1950-51 production figure was almost thirty-six million gallons, which is approximately three times the 1948-49 figure, only two years before. With production developing this fast, much had to be done in the marketing field to sell these enormous increases in production.

During the first years of production, marketing was limited mainly to hotel, restaurant, and soda fountain trade. These ventures were so successful that considerable quantities were beginning to be marketed in the retail food stores in 1947. The expansion of frozen orange

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1. Pubols, Ben H. New Orange Product Rapidly Wins Place in Breakfast Menu. The Agricultural Situation, United States Department of Agriculture, Washington, Volume 34, No. 4, April 1950, p. 10.

concentrate in retail food stores is growing continuously. Also, the availability of more suitable refrigerated display cases in retail stores should help to increase the market expansion of orange concentrate. Frozen orange concentrate was the number one seller among frozen foods in 1950.

The industry is also increasing its effort to develop dispenser sales to consumers in public places. They have been experimenting with dispenser units for soda fountains, bus stations, hotel lobbies, and theaters that will mix (reconstitute) orange concentrate just before the point-of-sale. These dispensers operate similar to the well-known Coca-Cola dispensers currently in use in drug stores. The use of these dispensers will increase the consumption of orange juice tremendously, if it can be sold from strategically located dispensers similar to the ones used in the soft drink field.

The percentage of families buying frozen orange concentrate at least once a month in 1951 was estimated at 20 percent of the population.[2] This approximation shows how few consumers orange concentrate reaches from the potential food market. Even with its rapid growth in production and marketing facilities, orange concentrate is far from saturating the available market.

Frozen orange concentrate has its greatest acceptance and sales in the northeastern and north central part of this country.[3] This is

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2. Anonymous. Frozen Food Factbook. New York: National Wholesale Frozen Food Distributors, Inc., 1952, p. 37.

3. Ibid. p. 44.

probably due to the greater centralization of population in this area, which caused it to be developed. In 1951, approximately three-fourths of the retail purchases were in this area. The remaining sales are almost equally divided between the southern, mountain and southwest area, and pacific coast states.

Orange concentrate, as a technological advancement, has definitely increased the consumption of orange juice. It gives a better and more uniform product to more consumers, because it removes the seasonal influence of producing areas from the consumer market. It is available twelve months out of the year in any place that has adequate refrigeration facilities. This was not true with fresh oranges, because the producing areas were far removed from the central markets.

Orange concentrate is also a space saver. It takes less storage room in all of its phases of production and marketing than does fresh oranges and canned single-strength orange juice. Its best selling point is its easy and convenient method of preparation. It has definitely given orange juice a more universal appeal to the consumer than it has ever had in previous years. Another of its many reasons for successful acceptance is that it eliminates waste and preserves the quality of the juice to its best advantage. To date, one of its greatest drawbacks is its high cost of distribution, which is slowly being reduced with more adequate facilities and marketing experience by the industry as a whole.

There are several factors that will determine whether or not frozen orange concentrate producers will continue to expand and develop the rest of the potential market in this country. Price, quality and

availability are a few of these important factors that must be given consideration. The consumers already have indicated that they will not pay over a certain price for orange concentrate. This fact was demonstrated clearly in 1949, when sales fell off considerably after retail prices were raised. At that time, the concentrate producers were paying high prices for oranges. This was brought about by the competition of different types of processors and the fresh fruit market for the available orange crop. This keen competition ran the orange prices on the tree to above $3.50 a box in Florida before it stopped. This was the highest average price in twenty years for Florida fruit, and it was one of the largest crops in Florida's history at that time. California was just beginning concentrate production at this time and was not affected to any great extent.

With the cost of frozen orange concentrate rising because of the increasing prices of oranges, market sales almost stopped when a six-ounce can sold for thirty-two to thirty-five cents. This left most concentrators with a tremendous carry-over of warehouse inventory. They had a product that they could not sell at cost. To move this large volume of orange concentrate, prices were reduced and sales picked up. Here was where the young industry learned a hard lesson. Consumers did not buy orange concentrate in much volume over twenty-nine cents for a six-ounce can.

In moving these large backlogs of production, the retail prices were lowered to less than twenty cents for a six-ounce can. In some cases, two six-ounce cans sold for thirty-five cents. These prices

moved out the large amount of warehouse inventories that processors had, but at a considerable loss to the processors. This fact has caused many processors to show a loss instead of a profit for their first several years of operation. For example, one of the largest producers of orange concentrate had a four million dollar inventory loss in 1951.

At the same time, there was an increase of brands on the market. At the present time, there are approximately seventy-five brands on the market. When this first increase in brands moved on to the market, quality was sacrificed in many cases. Not only was the price too high for the consumers, but the quality of some brands was not up to par, which caused further reduction in sales.

The large carry-over of inventories and reduced sales forced many of the small producers almost out of the business because they had to sell at such reduced prices to move their warehouse inventories. However, the industry is now on a more firm position with higher standards and production requirements which they did not have several years ago.

The raw material for orange concentrate must be obtained at a fairly level price if the industry is going to market its product at a consistent price which the consumer will pay. Fresh oranges have always had a great deal of fluctuation in their prices. Large changes in the price of fresh oranges from season to season create an element of unstability in the marketing of orange concentrate. Orange concentrate is stored in warehouses the year round and represents large

inventories at an already determined value. If the price of oranges decreases and a new pack of orange concentrate is produced at a lower cost, who is going to take the loss in reduced inventory values? This is one of the big problems that is confronting the concentrate industry today. Different organizations have tried to handle this in several ways with the main objective of sharing part of this risk with the fruit growers. These plans are reaching results with varying degrees of success.

The orange concentrate industry has solved many problems in production and merchandising of their product. It has been a constant trial and error process to determine the right method of operation. They are producing a good quality product that the consumers want and demand. Refrigeration facilities in transportation equipment, warehouses, and in retail food stores are much better and are available in greater numbers today than they were several years ago.

The industry has found out many facts about the merchandising of orange concentrate. The fact that the majority of consumers currently will pay no more than twenty-nine cents for a six-ounce can of orange concentrate is evidence of one discovery. Merchandising men for orange concentrate are beginning to gain an understanding of the market from past experiences and are better able to market it to the consumers.

The industry now has the tremendous job of stabilizing the price structure of its marketing system. To do this effectively, they must be able to buy fresh oranges at a consistent level of prices that will not depreciate the value of the orange concentrate stored in warehouses.

If they solve this marketing problem as they have production and transportation problems in the past, they should continue to grow and expand even further from their top sales position in the frozen food industry.

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