

Mr. Hyde: Yes, there is every chance of getting those, but our whole thought has been an extension of the season into the summer months, and the only fruit that would move would be out of cold storage, and couldn't travel when loaded above the ship. Your movement is going to be South Africa. There is nothing in the world to stop us from giving you ventilated service, but I think you will find you will be penalized more than sufficient to offset that.

Member: One reason why I made that suggestion was because I notice this season, particularly with our anthracnose, and on my shipments arriving in Glasgow, Liverpool or London, I noted considerable more damage from anthracnose on refrigerated shipments than on ventilated shipments where the Temperature wasn't lowered and raised on the other side. When it arrives at the other end there is very little difference, but after the fruit comes out of the refrigeration and has set around in the auction room, I have had some rather distressing results on some of that fruit that had to set around.

Mr. Hyde: Were you present when the fruit was removed from the ship?

Member: No, but I had surveys made of it.

Mr. Hyde: Your fruit was probably picked a little too early. It was artificially colored, wasn't it?

Member: No, it was fully ripened fruit.

Mr. Hyde: The last cargoes I saw unloaded showed none of that storage pit whatever. The late fruit that is overmature and there is danger

of stem-end rot must be carried as close to the frost line as possible but with fruit that has been thoroughly sun-cured on the tree, there is no danger of that. My experience is that your early fruit that is good enough to go over there should be delivered in absolutely sound condition on about a forty degrees temperature mark, without your having any trouble whatever. A lot of you gentlemen will specify when your fruit goes in cold storage the temperature you want it pre-cooled at. Lots of cold storage people tell me their orders are to precool at thirty-two degrees.

Member: It is just in the past few weeks, particularly in the ridge section, that we have had this anthracnose develop. It develops sometimes even in New York shipments, but it seems when you bring it down under refrigeration that way it seems for some reason or other to break down on the other end, more so than straight ventilated shipments. We have had stuff in the house that we have picked and some of the worst, and treated it, and it stayed up in apparently good shape, and when we put it under ventilation, and it set around the office it had to be sold right now.

Mr. Hyde: I have seen that quite often, but I have seen none at the time of discharge from the ship. It has been developed later, due to weakness of the fruit, and I believe it stood up longer on account of the refrigeration than otherwise, and I think you are still better off. You are going to have competition with South Africa on the Temperature basis.

REFRIGERATION WORK IN THE EXPERIMENT STATION

By A. F. Camp, Agricultural Experiment Station, Gainesville

One of the outstanding needs of the citrus industry in Florida has been the extension of the marketing season. We have been faced with the necessity of marketing an ever increasing volume of fruit in a period of seven or eight months. This not only crowds the market badly but leaves several months during which Florida citrus fruits are not placed before the buying public. The

problem is further complicated by the fact that many of our varieties of citrus fruits have a very marked and comparatively short ripening period and must be shipped within that period. In addition to this we have for several months a very large market for citrus fruits within our own state which we cannot supply. As a result we have periods when, in large crop years, fruit is

present in a great surplus but so far we are without adequate means of holding this surplus over for the periods when we have a market and no fruit.

Some means of lengthening this period of marketing is greatly to be desired and it is natural to turn to the problem of cold storage as offering one of the most feasible answers. Cold storage has done a great deal for the apple industry and today we buy apples months after they have been picked. This extension of the apple season has been of untold value to the apple growers and gives us a key to what might be possible in the citrus industry along the same lines.

With methods available by which citrus fruits could be held safely for from three to five months, it would be possible to eliminate the present shipping peaks which injure the market and to carry the extra fruit over into periods when the pressure on the market is lessened. It would also be possible to carry fruit in storage through the summer to supply our own and other summer markets and further relieve the winter markets. By relieving pressure on the market at critical times and supplying markets now unsupplied it would be easily possible to add tremendously to the value of our citrus crop.

Unfortunately considerable difficulty has been experienced in the cold storage of citrus fruits. The results have been uncertain and the losses heavy; where many have succeeded splendidly, followers in their footsteps have experienced heavy losses. A great deal of work remains to be done before we can get the best results from cold storage but it appears to offer the best available possibility for extending our citrus season immediately with the grove acreage now planted.

Together with cold storage of fruit, we find developing the idea of marketing the fruit in other forms than as fresh fruit, i. e., as canned fruit or juice, frozen juice, marmalades, etc. The canning of grapefruit already offers a market for sound grapefruit that is unsightly in appearance or off size. This relieves the pressure on the fresh fruit market and permits the more slightly grades of fruit to be marketed to better advantage. A similar relief is to be hoped for in the orange marketing situation as the result of the establishment of the marketing of frozen orange

juice. This product is being studied on a large scale in this state at the present time and upon the successful marketing of the large amounts of juice now being produced hangs a great deal of interest.

Like the canning of grapefruit, the marketing of frozen orange juice tends to relieve the market congestion for fresh fruit and also to extend the marketing period into those months when we ordinarily do not have fresh fruit available. To a certain extent these products compete with the fresh fruit but all plans have their weak spots and in both of these cases the good effect should greatly outweigh the ill effects. The last three seasons have shown strikingly that the marketing of a small amount of fruit is much more profitable than the marketing of a large amount and it is hoped that these various outlets for No. 3 fruit will enhance the value of the higher grade.

Realizing the importance of the above considerations we have, during the past year, constructed at the Experiment Station at Gainesville an experimental refrigeration plant with which we hope to be of some material help to the industry in solving some of the problems pertaining to the cold storage of fruit and the freezing of fruit pulps and juices. We now have available six rooms for storage experiments and these are being run at the following temperatures: 30, 36, 42, 48, 54 and 60 degrees Fahrenheit. Each of these rooms is controlled accurately within one degree Fahrenheit (1°F.) and each is capable of accommodating a half carload of fruit without interfering with proper air circulation or the accurate maintenance of temperature. With this range of temperatures it should be possible to have temperatures both above and below the optimum storage temperature—a very necessary requirement in carrying on experimental cold storage work.

In addition to the storage rooms we have two freezer rooms—one operating from 0°Fahr. to -10°Fahr. and one at +10°Fahr. These rooms are for use in carrying on experiments on frozen products and are chiefly used for the storage of such products. Some additional facilities for this work in the shape of a small quick freezer are being installed and will be ready shortly. This equipment will include a small low temperature

brine bath operating at -20° to -30° Fahr. or any higher temperature desired and furnish brine for any type of equipment desired. Lower temperatures than -30° Fahr. are obtained with Dry-Ice but such temperatures are not ordinarily necessary in fruit work. With the above equipment we will be prepared to handle all ordinary lines of research on frozen products and cold storage that may arise.

In the handling of citrus fruits in cold storage there are three chief problems: (1) the drying out of the fruit; (2) pitting of the rind, and (3) decay. We are planning experiments designed to throw additional light on all of these problems. We already have work started by a graduate student, Mr. Fifield, on the use of various types of wrappers such as waxed paper, oiled paper, Cellophane, parchment, aluminum foil, etc., to determine the influence of such wrappers on keeping quality of the fruit. This work is being carried on at all temperatures as the fruit frequently reacts differently to temperature when different wrappers are used. Other work on the effect of surface coatings and other treatments has been started and we have a few fruits that have been kept in good shape since the middle of December, 1930. The effect of temperature and humidity is, of course, of fundamental importance but the situation is complicated when the fruit reacts differently to temperature, according to treatment and wrapper. As usual the amount of stem-end rot in stored fruit has been discouraging but it is hoped that the Plant Pathology Department will be able to aid in the solution of this vexing problem.

Beyond the immediate problems we find the very difficult problem of estimating the value and importance of the effect of cultural treatments on the keeping quality of the fruit. This field will have to be extensively explored and we are planning work with this particularly in mind. It is not at all improbable that in years to come citrus fruits may be cultured particularly for cold storage, the fertilization and cultivation being adjusted to this end. In any such experiments the variety and rootstock and the soil as well as the fertilizer and cultural treatments will have to be considered.

There is an additional problem in such work and that is the problem of what happens after the fruit is removed from storage. Fruit may keep in splendid condition in the storage rooms but go to pieces in a very short time after it is removed from storage. This is not important where the fruit is being removed from storage and immediately juiced as has been the case in some of the northern cities where companies operating orange juice stores have stored fruit for summer use and removed the necessary amount of fruit each day. It is a problem of prime importance, however, when the fruit is to be merchandised through the regular channels so that it will be out of storage two days or more before being consumed. All of our work calls for the examination of the fruit at various intervals after removal from storage in order to take care of this important point.

In addition to work on citrus we are also studying the effect of storage on other fruits and another graduate student, Mr. Lyle, is studying the storage of avocados. This work has already developed some very interesting angles. I hope that at the next meeting of this society he will be able to offer a very interesting paper along this line.

I want to turn now for a moment to the question of frozen products. When Mr. Clarence Birdseye started the quick freezing of fish he started what has developed into the beginnings of a great field of work. The idea of merchandising perishable foods in individual containers in a frozen condition bids fair today to affect modern horticulture as extensively as did the tin can a few years ago. Already meat and fish in frozen package form are standard products and such horticultural products as raspberries, spinach, peas, peaches and now orange juice are being extensively marketed and received with great favor. Many of the products are the equal of the fresh material in quality and are even indistinguishable from it.

In the not distant future the housewife in our larger cities will be able to buy a complete dinner in the frozen state and with the simplest preparation place it on the table. I recently had the pleasure of eating a luncheon made up almost entirely from frozen products—fish and steak of the very best, peas, asparagus, and corn indistinguishable

from the fresh product, and frozen raspberries and cream for dessert—all of the products frozen last summer.

The limitations of this sort of marketing are rapidly being eliminated. Processes are being worked out for freezing various types of products and the best varieties for freezing and the best type of package for marketing are being determined. The refrigerator companies are designing show cases for displaying products in stores in the frozen condition and electric house refrigerators are coming out with compartments for holding frozen foods.

This development is separate from the bulk freezing of fruits that has been used in some fields for several years. Strawberries, for instance, are packed in a large scale for preservers, the fruit being packed with sugar in barrels and frozen and retained in this condition until the preserver is ready to use it. Fruit is now being packed in this way in Florida for shipment to northern canners and to pie bakers. This sort of thing is quite different from the development of the individual package method of freezing in which the product is frozen in a package of suitable size for home consumption.

The freezing of orange juice is a part of this great development and will have in its favor the great national trend toward frozen products that is now taking place. Additional impetus has been given to the movement by the difficulties attached to canning the juice successfully. Two companies are now freezing the juice on a large scale, using the individual package and intend to deliver it by milk wagon through their present distributing system. So far the work of marketing this new product is proceeding under the most favorable auspices and the highest standards are being maintained in the production of the product.

Just what the future of this development will be it is difficult to say. Much will depend on the large scale experiments now being carried on. Probably at this point a note of warning should be sounded against too optimistic expectations. As now constituted, the juice plants offer an outlet for No. 3 fruit similar to the outlet offered

in the grapefruit industry by canning. The companies involved are expending large amounts of money in this work on this basis, whereas there has been a tendency in some quarters to expect more of them. The growers of the state must work with them in developing this new industry if we are to benefit properly from its development. Florida is the natural setting for the development and we should strive to keep it here to as great an extent as possible. Other citrus areas are not asleep to the situation and are likely to offer inducements for such developments that we will have to combat in the future. Extensive experiments are already being carried on in California and some foreign countries along this line and we will have to keep pace if we are to hold our initial advantage.

There is still a great deal of experimental work to be done on frozen orange juice. We know far too little about the actual constitution of the juice and the factors influencing its keeping quality. The last word has not been said on methods of either extracting or freezing. The relation of varietal and cultural characteristics to the keeping quality of the juice needs to be determined. Much effort is being spent in determining the best means of keeping the counts of bacteria and yeast at the lowest possible point. Florida has a "head start" on these problems and we hope to maintain our advantage.

In addition to orange juice we have many products that we hope will be adapted to the freezing process. Already at the Experiment Station plant we have found tangerine juice to be an exceedingly palatable product and blends of it with orange juice of fine quality. Tangelo juice has a tang all its own and may prove to have real value commercially. Frozen grapefruit hearts are splendid in salad and as a dessert but more work needs to be done on their keeping quality. Many other fruits, such as mangoes, avocados, papayas, persimmons, blueberries, strawberries, etc., need to be studied. In this field we hope to lend a hand where it is much needed and to help retain for Florida as much of this industry as possible.