June, 1951

To the Graduate Council:

I am submitting to you a thesis written by Floyd Arthur Weems entitled "A Study of Methods of Freezing Sweet Potatoes As Compared to Dehydrating." I recommend that it be accepted for fifteen quarter hours credit in partial fulfillment of the requirements for the degree of Master of Science, with a major in Horticulture.

Homer D. Sudds
Major Professor

We have read this thesis
and recommend its acceptance:

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Accepted for the Council

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Dean of the Graduate School

A STUDY OF THE METHODS OF FREEZING SWEET POTATOES AS COMPARED TO DEHYDRATING

A THESIS

Submitted to

The Graduate Council
of
The University of Tennessee
in
Partial Fulfillment of the Requirements
for the degree of
Master of Science

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by
Floyd Arthur Weems

August 1951

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F.A.W.

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INTRODUCTION

The sweet potato is the most important vegetable crop in the South and in the State of Tennessee. Because of its adaptability to many processing requirements, its use as a fresh product, its value as a feed and for industrial purposes, the sweet potato has acquired local and national prominence.

While there have been both fresh and process outlets for vegetables, since commercial production became important in the United States, the importance of the processing market is rapidly increasing.

There should be a sweet potato product available to the consumer at all periods of the year. Sweet potatoes are available as a fresh product only during a short period of the year due to poor storage facilities, or poor quality potatoes resulting from storage diseases and rodents. It is important, therefore, that the supply be extended throughout the entire year. This may be accomplished with a product that has been processed in a form as palatable as the fresh product. The evaluation of quality is based on appearance, texture, flavor, odor, and nutritive values.

The purpose of this experiment was to develop a method for the preservation of the sweet potato which will yield a product attractive in appearance, acceptable in quality, that may be prepared for the table in a variety of ways, and sufficiently resistant to atmospheric conditions to permit

storage and distribution.

Preliminary experiments with several fruits and vegetables have shown that moderate dehydration, removal of about two-thirds of the water content, followed by freezing storage, resulted in excellent products in most cases. It would appear that there would be some possibilities with sweet potatoes.

As the name implies, dehydrofreezing is a new method of food preservation which combines certain features of two well known processing methods. The process like the name, links dehydration with freezing preservation and is designed to retain the advantages of each of these established procedures while eliminating insofar as possible the disadvantages of each.

The advantages of dehydrofreezing are mainly the economic and engineering advantages which are attributed to the new dehydrofreeze process. Economies are very substantial in terms of warehouses and refrigerated transport space.

The lines of investigation included a comparison of dehydration, dehydrofreezing and freezing following various pre-treatments.

REVIEW OF LITERATURE

The importance of freezing, dehydrofreezing of fruits and vegetables cannot be more greatly emphasized than the economic and engineering advantages.

Research workers (23,29,30,31) found sweet potatoes to peel best by placing them in wire baskets and dipping in a solution of ten per cent lye solution four minutes for uncured stock and six minutes for cured potatoes. The peel of the sweet potato increased in thickness and toughness during the two weeks required to cure, which required twenty-five per cent longer for the lye to penetrate the peel and the loss on peeling with lye, steam, or manually was ten per cent more. An initial concentration of ten per cent lye solution was used, supplemented with additions of one pound of lye for each bushel of potatoes treated. Lye peeling, whether at concentrations of two and one-half, five, seven, or ten per cent resulted in a loss of from twenty to twenty-five per cent of the unpeeled weight. Peeling in boiling water for a period of fourteen minutes resulted in an eighteen to thirty per cent loss in weight. Discoloration of the above stock was found due to: (a) potatoes which were diseased, insect infested, improperly cured, sprouted, or stored at too low temperature; (b) peeled or cut, sound potatoes turned dark brown at the sur-

face, on the stem end when exposed to air; (c) sweet potatoes heated by boiling, baking, or steaming turned deep blue-green after prolonged and intense heating; (d) contact with iron caused cooked or uncooked potatoes to turn black; (e) sweet potatoes heated above 300 degrees Fahrenheit.

In his research and studies, Mazzola (18) found that by using a hot concentrated lye solution above twenty per cent so reduced the time, that peeling losses due to partial cooking were greatly reduced. Waste was as low as three per cent with immature potatoes and never higher than twelve per cent for mature U. S. No. 1, the average being eight per cent. Cruess and MacKinney (6,7) did successful peeling of sweet potatoes with lye solutions as high as fifteen per cent at a temperature of 212 degrees Fahrenheit.

Studies made by Scott (23, 24) on the conditions requisite for development of discoloration, followed that discoloration may be accomplished by either: (1) maintaining the temperature of the product below the critical minimum of fifty-five degrees centigrade throughout the lye peeling process or bringing the tissue temperature of the product to a point adequate for inactivation of the enzyme system responsible for discoloration (above ninety degrees centigrade). With roots having an initial temperature of sixty degrees centigrade it was found that after immersion in water for a five minute period, temperatures at the cambium area

was eighty degrees centigrade. This was well above the minimum for heat discoloration, but not high enough to inactivate the catechol oxidase. It was found that heat discoloration was confined largely to the area just beneath the cortex. This discoloration developed shortly after removal of the roots from the lye peel bath and was found to be neither initiated nor increased during subsequent blanching and dehydration. It was pointed out that this type of discoloration was not comparable with that observed by Caldwell and fellow workers (2) which was abiotic in nature as it was not prevented by heating the roots to 120 degrees Centigrade. The advantages derived from preheating are: (1) prevention of discoloration; (2) greatly decreased amount of trimming belt; (4) the tedious job of inspection required to remove defective pieces was greatly lessened; (5) a much brighter product resulted from the preheated product upon cooking.

Iungerich (15) found thatenzymes which cause discoloration in fresh fruits and vegetables were inactivated by immersing for ten to twenty seconds in boiling three to five per cent acetic acid and 0.85 per cent sodium chloride or by soaking fifteen to twenty minutes in such a solution at room temperature and then dipping in a one per cent sodium chl.

solution for five seconds.

Studies made by Prescott and Shuey (22, 26) indicate that steam blanching for a period of six to eight minutes was necessary for sliced sweet potatoes for dehydration. Studies made by Woodroof (32) indicate that steaming at ten pounds pressure, from ten to thirty minutes, according to the size of potatoes, was necessary to inactivate enzymes which cause discoloration, to loosen the peel and to soften the tissue so that it could be easily pulped or sliced. Blanching, by scalding, prior to freezing or dehydrating prevented undesirable changes by enzymes during storage, but reduced aroma, flavor, and soluble nutrients.

Von Loesecke (28) found blanching by steam at atmospheric pressure to be best accomplished by a continuous blancher where the material attained a temperature of at least 190 degrees Fahrenheit within six minutes or until peroxidase was inactivated. He also did blanching under pressure by placing the product in baskets in a pressure cooker and heating to 240 degrees Fahrenheit, and with hot water blanching at 190 degrees Fahrenheit.

In preliminary experiments made by Chase (4) electronic heat in the form of radio frequency waves was used in lieu of steam or boiling water for blanching purposes. In the preliminaries, frequencies of seven to ten and twenty-eight to twenty-nine megacycles were used, the application of

sufficient radio frequency power to cause the rapid heating of diced potatoes resulted in arcing between electrodes and any projecting vegetable tissue. There also was burning between individual pieces, although the tendency to arcing or flashover was less at the high frequencies.

An analysis of these samples showed a negligible loss of ascorbic acid during the electronic blanching in contrast to the thirty to forty per cent losses occurring in the steam and water processes points the way to production of processed vegetables of higher nutritive value.

In their investigations of freezing sweet potatoes, Foster (11) found that freezing: (a) gives a product that is similar to the fresh, in appearance, color, texture, and flavor; (b) frozen sweet potatoes, usually had, however, a slightly softened texture, slightly faded color, and slight storage flavor.

Engdahl and Foster (10,11) found through experimentation with sweet potatoes that this product should be frozen at -10 degrees Fahrenheit or lower in some form of quick-freezing chamber or room, preferably in a freezer where a blast of air at -10 degrees to -30 degrees Fahrenheit is blown over the product. However, where quick freezers were not available, small amounts of the product was frozen quite satisfactory at 0 degrees Fahrenheit in still air, provided the packages

were placed on or against the freezer plates, or space was left between them so that freezing would take place readily.

Woodruff and Plagge (32, 21) found a slow freezing temperature of 0 degrees Fahrenheit or approximately this temperature was most satisfactory for the freezing and storage of sweet potatoes which were prepared and packaged by the standard frozen pack method. Freezing-preservation preserved the vitamin C better than the other methods of preservation.

In preliminary work, Talburt (27) dehydrofroze peas with satisfactory results. Initially and after six and twelve months storage at -10 Fahrenheit, there was little difference between cooked dehydrofrozen and frozen peas where weight reductions of fifty per cent of the raw material was employed. Further dehydration, up to 60 per cent of raw weight, resulted in some loss of desirable color, but did not effect other organoleptic qualities. Cooking methods were similar for dehydrofrozen product and the frozen product because the dehydrofrozen product did not require preliminary soaking prior to cooking.

Experiments were conducted by Howard (13) using dehydrofrozen products including white potatoes, peas, carrots, asparagus, cherries, boysenberries, and apricots. They were reduced to a series of moisture contents, frozen at minus thirty degrees Fahrenheit and stored at minus ten degrees

Fahrenheit. After various periods they were prepared and presented to taste panels with controls frozen in the usual way without dehydration. All of these products gave satisfactory results, with the exception of asparagus, which was a complete failure.

Studies made by University of Tennessee Experiment Station workers (12) indicate the cabinet should be 150 degrees Fahrenheit before the potatoes are introduced. When the products have reached 150 degrees Fahrenheit, the dampers should be cracked. Exhaust air should carry sufficient moisture to dampen the back of the hand when placed in the exit. As the drying progresses, the dampers should be opened gradually to take care of the excess moisture.

In dehydrating experiments Woodroof (30) found during the heating period the temperature of the air (dry bulb) should be 170 - 200 degrees Fahrenheit. The moist product (wet bulb) will remain at 145 - 150 degrees Fahrenheit. Dehydration can begin at a high temperature and humidity and which are gradually reduced as dehydration processed.

Other research workers (1,2, 3,9,19,20,22,28) found in their studies of the dehydration of sweet potatoes, an initial dehydrating temperature of 150 - 160 degrees Fahrenheit and a final temperature of 140 - 145 degrees Fahrenheit was best under average conditions.

According to work on dehydration of sweet potatoes by Shuey (26), the initial temperature should be 165 degrees

Fahrenheit for the last half of the drying period. Since this work was conducted under Tennessee conditions, we followed this procedure in our experiment.

Chenoweth (5) found as a general rule, the higher temperature should be applied during the last stage of the process. If the temperature of the air is too high and dry during the initial stage of evaporation the exposed surface of the product becomes seared or over dried. This checks the flow of internal moisture to the surface and delays drying.

The carrying capacity of the air is doubled with each increase in temperature of twenty-seven degrees Fahrenheit. Heat plays an important part in the evaporation of moisture, first, in bringing the temperature of the water to the point to which the material is raised during drying, and second, it furnished the heat necessary to convert water into vapor at the temperature level reached by the drying material. Heat also increases the rate of transmission of water through the cell walls, thereby assisting its passage from the interior to the surface of the material as increasing the vapor pressure of water. Heat increases the water carrying capacity of the air.

Howard (14) in experiments on the dehydration of vegetables, found solid perishable foods, such as sweet potatoes, may be preserved by partial dehydration, (from 66 per cent to 12 per cent water content), compressed, if necessary

or desired, and subsequently frozen. The potatoes must be kept in frozen storage.

According to work done by Sherman (25), vegetables, including sweet potatoes, were first dehydrated by conventional methods to lose eighty per cent of their moisture content. They were then compressed into bricks and the remaining moisture wa s removed by electric heat up to ninety-nine per cent without impairing the quality of the vegetable or causing "case hardening."

Derby (8) made studies on dehydration, using raw fruits and vegetables, including sweet potatoes, which were converted into high quality dehydrated products. The air was replaced with an aqueous liquid, which was dissipated by dehydration. Carbon dioxide and nitrogen were used to break the vacuum in the container after sufficient air has been removed from the material. Aqueous solutions of seven per cent sugar and seven per cent starch resulted in the impregnation of sugar and the coating of starch on the potatoes.

Dehydrated sweet potatoes were soaked in water for one hour in an investigation carried out by Von Loesecke (28), and then were boiled for thirty minutes. Soaking less time gave inferior products as compared to one hour of soaking. He obtained best results by using one and one-half times as much water as potatoes.

EXPERIMENTAL PROCEDURE

The preparation of the sweet potatoes began with washing and grading of desirable stock fresh from the field and potato storage. All the material used in the work was U.S. No. 1, U.S. No. 2 and "jumbo" stock. The stock was washed by emptying the sweet potatoes from the crates into a large tank of water to loosen adhering dirt and completing the cleaning process by the use of a brush when necessary. As a part of the washing process, the roots were closely inspected for indications of disease or decay. Specimens showing disease or decay were severely trimmed or discarded.

Two methods of peeling were used as indicated in Table I in an attempt to find one that would combine rapid and effective removal of the skin with minimum loss of edible material while leaving the roots in the best condition for the subsequent treatments. These two methods used in this experiment were lye-peeling and steaming under pressur e.

The stock to be steam-peeled was taken immediately from the washing tank, placed in a mesh basket and immersed in live steam in a retort at ten pounds pressure for fifteen minutes, after which the product was cooled in running water and the peels slipped off by hand. The steaming process for fifteen minutes permitted removal of the peels with some loss of edible material. It had further advantages, in

FIGURE I.

PROCESSING PROCEDURE FOR THE SWEET POTATO

(Freezing, Dehydrofreezing, and Dehydrating)

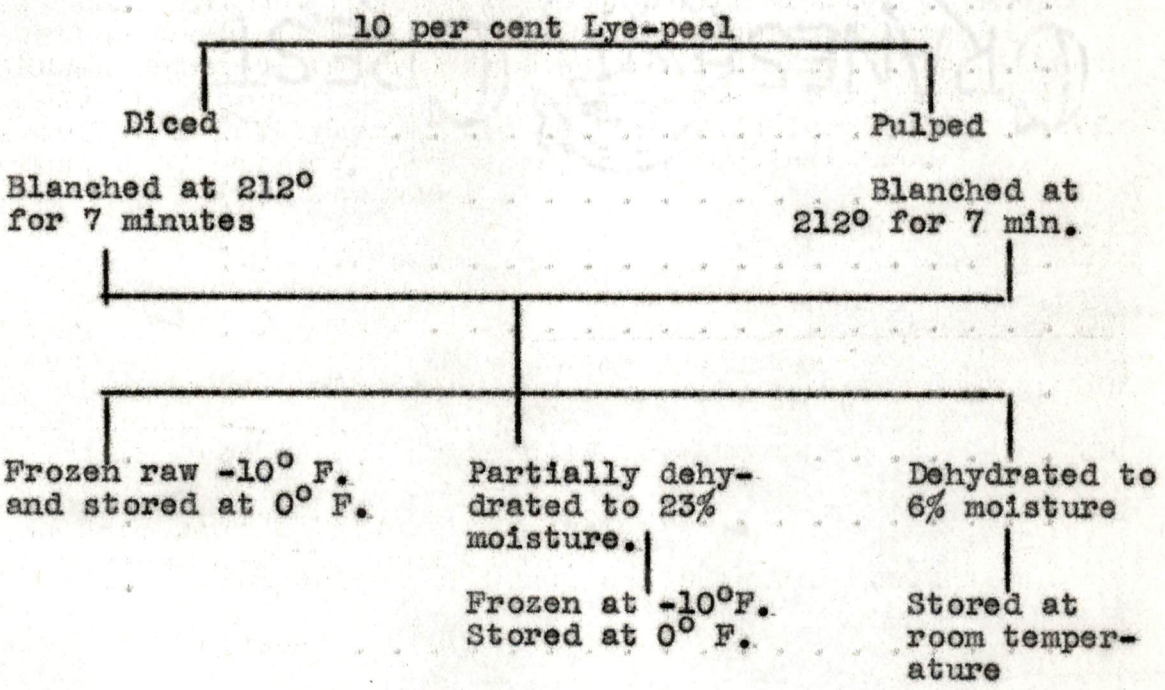


FIGURE I.

PROCESSING PROCEDURE FOR THE SWEET POTATO

(Freezing, Dehydrofreezing, and Dehydrating)

(continued)

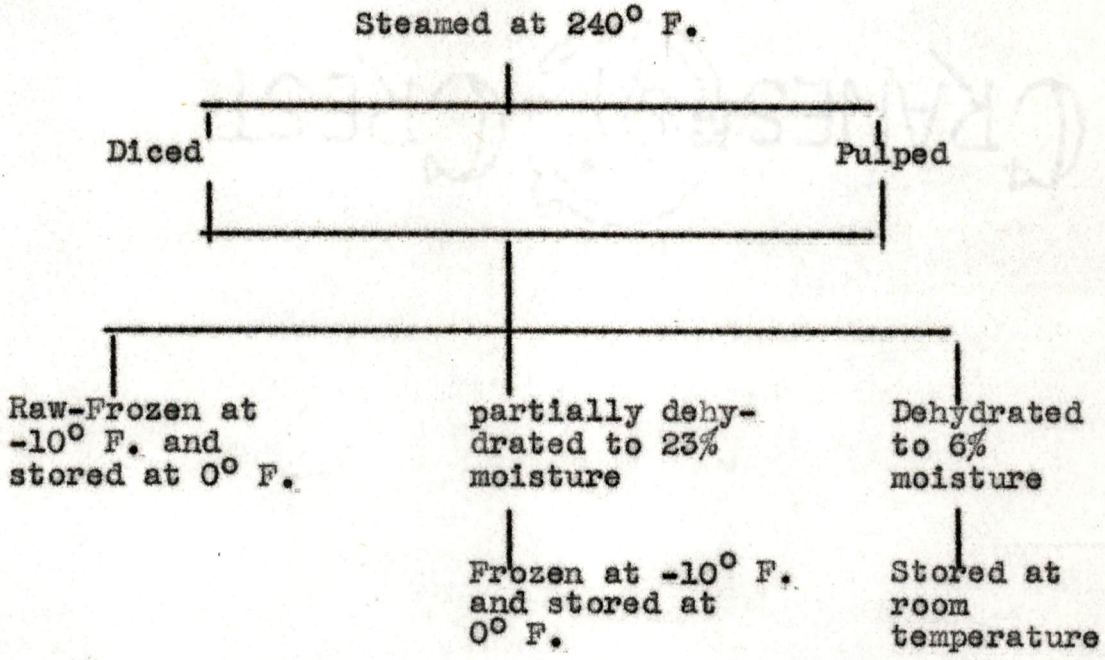
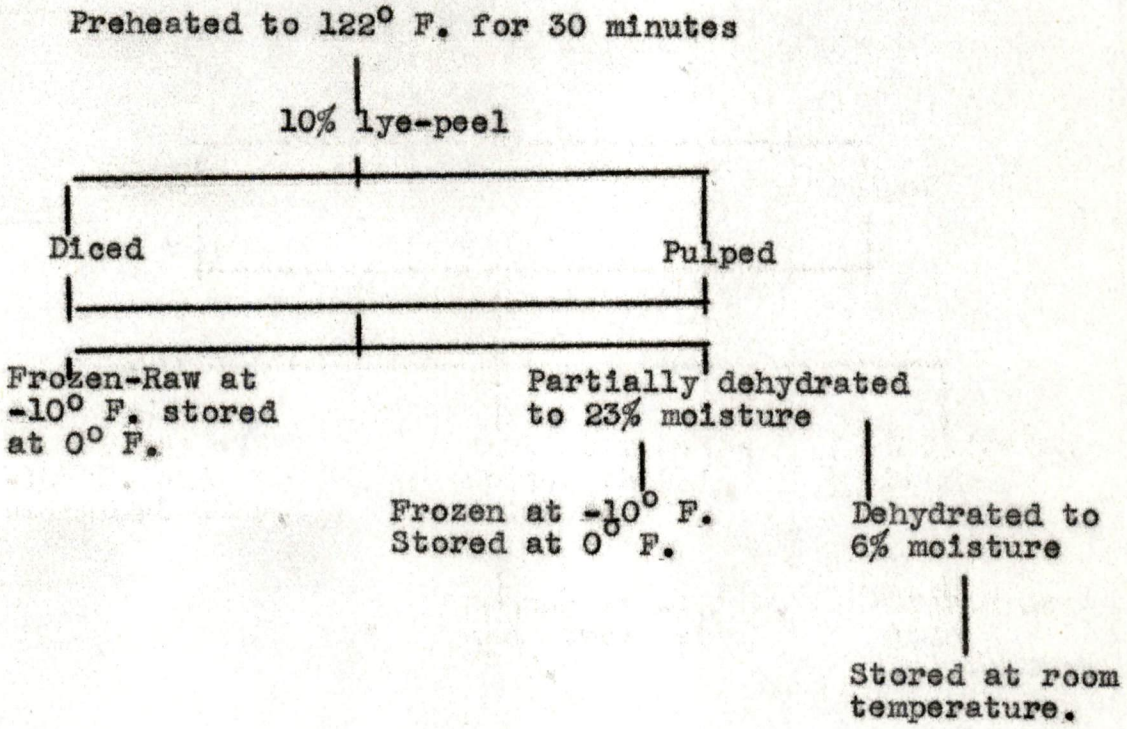


FIGURE I.

PROCESSING PROCEDURE FOR THE SWEET POTATO

(Freezing, Dehydrating, and Dehydrofreezing)

(continued)



that the sweet potatoes were considerably softened, particularly at the tips and much breaking and crushing occurred in the subsequent slicing and dicing. The slices tended to adhere in masses, making handling during dicing, spreading on trays for drying, and partial drying difficult. This was partially overcome by spreading out the prepared product and leaving the surface area to dry for five to ten minutes at room temperature. This greatly facilitated the uniform spacing of the diced and pulped product on the trays.

The lye-peeling process consisted of removing the stock immediately from the washing tank and immersing it in a ten per cent solution of commercial concentrated lye (caustic soda or caustic potash) kept at boiling temperature. This treatment was very effective in removing the peels when the treatment was properly controlled. In this experiment the lye-solution was made up in an emameled tub heated by a gas flame. The time required for loosening the peels varied and increased after curing and short storage as a result of thickening of the periderm. The time determined for any particular lot by observing the degree of splitting and loosening of the skins occurring as the potatoes were stirred. Submerging of the uncured stock for five minutes and submerging of cured potatoes for seven minutes gave good results. The potatoes were lifted from the lye-bath at the

end of this period and placed in a tank of running water. This loosened and removed most of the peels; portions adhering could be readily moved by hand.

There was practically no loss of edible material when the lye-peeling process was properly controlled. The lye penetrated the parenchyma beneath the cortex only to the extent of about one-sixteenth of an inch. This very thin layer softened and gelatinized, loosening the periderm and permitting it to be slipped off easily. This method has the advantage that potatoes of irregular shape with large veins were peeled as easily as those of smooth, uniform shape. Paring was not needed to complete the peeling process with fresh stock. Stock that had been cured and held in storage for a short period needed some knife work, as the periderm of the shriveled tips and about the healed cuts and bruises did not loosen properly under lye treatment. Lateral roots that held portions of the loosened cortex in place, required removal by hand.

Examination of the sweet potatoes during the washing process permitted discovery and discarding of badly decayed roots, but a further close inspection of the peeled stock was necessary, as it revealed early stages of decay not evident prior to peeling. The tips of the roots were examined for discoloration of the vascular bundles or other evidences of disease, and those showing such indications were

discarded or heavily trimmed.

A disadvantage of this method of peeling was the tendency to cause discoloration when the product was diced or pulped.

In this work discoloration was one of the chief difficulties to be overcome. The first method used to overcome discoloration was to wash the potatoes thoroughly, place in water held at a constant temperature of 122 degrees F. for thirty minutes before lye-peeling. By this method discoloration at the surfaces for the diced cubes and the pulped product appeared rather promptly after the material was placed in the drier and increased and deepened in color as the drying advanced. This darkening disappeared slightly during the process of reconstitution and cooking the material after being in storage, but when the product was left to cool a short time this darkening reappeared. This was evident in all three treatments, whether dehydrated, dehydrcfrozen, or frozen raw.

The second method used for prevention of discoloration was blanching following dicing and pulping. The blanching time was pre-determined by the peroxidase test. Four samples were lye-peeled, diced, and blanched in water at 212 degrees F. for periods of two, five, seven, and ten minutes, relative in positive for two minutes, positive for five, negative for seven and ten. This was followed with four

samples which had been lye-peeled, pulped and blanched for periods of two, five, seven, and ten minute periods, which gave positive for two minutes, positive for five, slightly positive for seven, and negative for ten minutes respectively.

The method for preparation of sweet potatoes for pulping was identical with that followed with diced insofar as washing and peeling with lye was concerned, but differed in later steps. The peeled sweet potatoes were sliced and pulped by passing through a food chopper having numerous holes, blanched in water at 212 degrees F. for ten minutes and spread on trays. One-third of the sample was dehydrated from a moisture content of approximately sixty-seven per cent as indicated in Table II, to a moisture content of approximately twenty-three per cent as indicated in Figure I and frozen at -10 degrees F. and stored at 0 degrees F; one-third was dehydrated until an approximately six per cent moisture content was attained as indicated in Figure I and stored at room temperature and the remaining one-third was packaged, frozen raw at -10 degrees F. and stored at 0 degrees F.

TABLE I

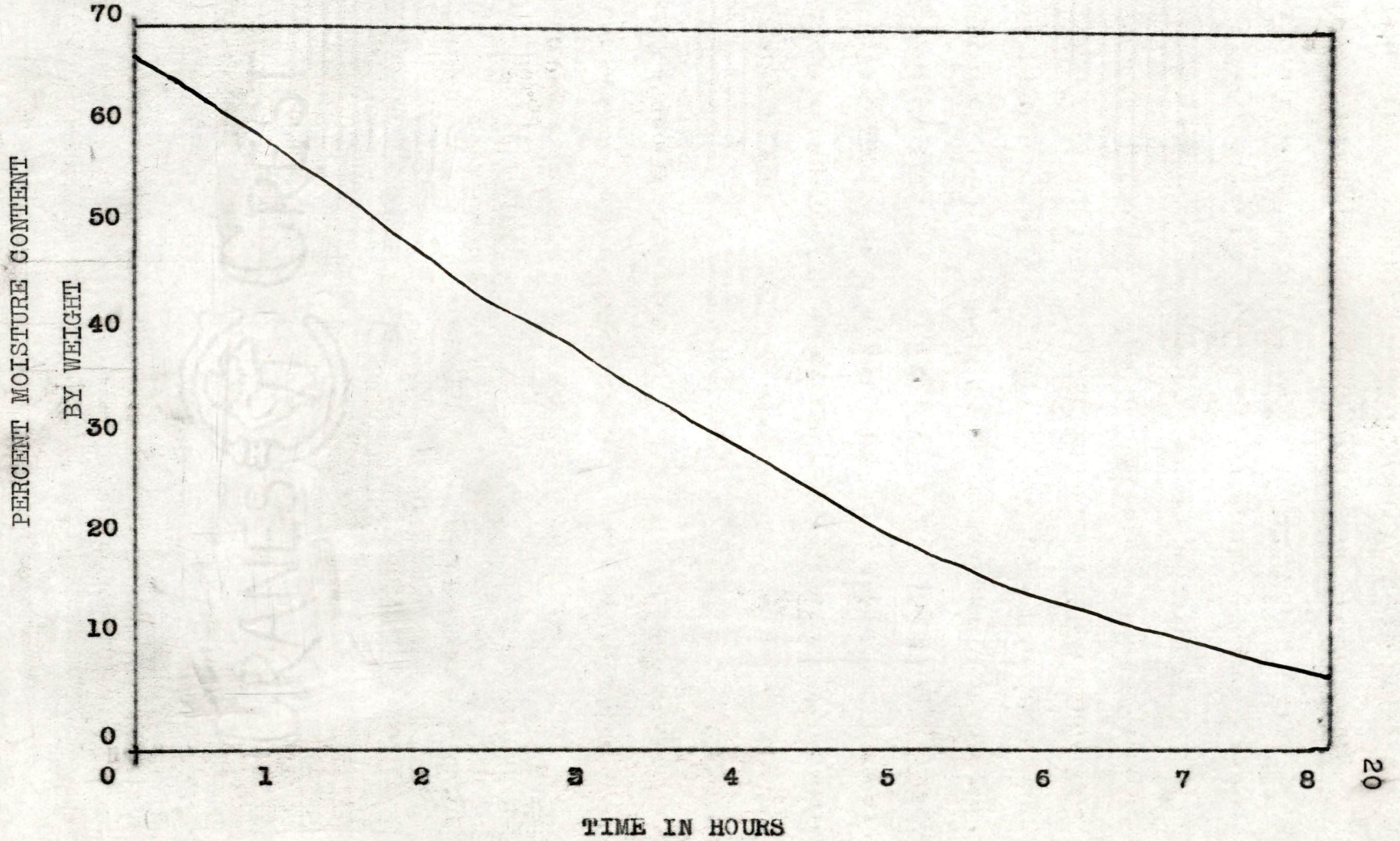
TOTAL MOISTURE CONTENT OF UNCURED AND CURED PORTO RICO SWEET POTATOES

Sample Number	Percent Moisture (cured stock)	Per cant Moisture (uncured stock)
A 1	67.5	67.4
2	67.8	69.2
B 1	72.4	64.9
2	59.8	65.4
Average	66.9	66.7

FIGURE I

AVERAGE TIME REQUIRED FOR DEHYDRATING

THE PORTO RICO SWEET POTATO



The method for the preparation of pulped potatoes that were steam peeled was somewhat different. They were sliced and passed through a food chopper. The pulp issued in continuous glutinous strands forming an untwisted hank that could be drawn out to considerable lengths. The strands were separated and placed side by side upon trays which were placed in the drier as soon as possible. Due to the fine subdivision of the material and the porous character of the strands, partial dehydration was completed within four to five hours, as indicated by Figure I. Considerable difficulty was encountered in preventing discoloration when the sweet potatoes were pulped. Most discoloration occurred with those lye-peeled and pulped. Less occurred when potatoes were steam-peeled. The process of pulping incorporated so much air into the material that darkening occurred quite rapidly and generally throughout the strands of drying material.

The method for the preparation of sweet potatoes for dicing was the same for pulped, lye-peeled and steam-peeled. The potatoes were sliced across the diameter into slices three-sixteenths inches thick and immediately diced with a vegetable dicer to cubes of three-sixteenths inch dimensions. The diced product was divided. One-third was dehydrated to approximately six per cent moisture as indicated in Figure I. One-third was dehydrated to approximately 23 per cent moisture.

content, frozen at minus ten degrees F. and stored at 0 degrees F. The remaining one-third was packaged, frozen raw and stored at the same temperature.

The dehydrating equipment was a verticle type dehydrator, electrically heated with forced ventilation, as illustrated in University of Tennessee Agricultural Extension Service Leaflet No. 60.

The prepared product was placed on twelve by eighteen inch trays at the rate of 1.5 pounds per square foot and these trays were placed in the dehydrator on wooden cleats nailed two inches apart for proper air circulation. Dampers were used at the lower and topmost areas of the dehydrator for the regulation of the humidity, measured by means of a wet and dry bulb thermometer.

The potatoes to be dehydrofrozen were weighed before placing in the dehydrator and at intervals until the moisture content was reduced to twenty-three per cent. They were removed upon completion of the drying period, packaged in moisture-proof containers and frozen at minus ten degrees Fahrenheit. The remaining part was left in the dehydrator for a longer period until it reached a six percent moisture content, as indicated in Figure I.

The danger of case-hardening was minimized by passing currents of hot air over a container filled with water, having a large surface area for evaporation.

In all the dehydrating work, dehydration was begun in air having a temperature of 145 - 150 degrees F. and a relative humidity of thirty to thirty-five per cent. As the dehydrating proceeded, the air temperature was progressively increased and relative humidity decreased. The process was finished with an air temperature of 160-165 degrees F. and a relative humidity of 12 - 15 per cent. By regulating the dampers, together with the regulation of heat within, a uniform temperature and relative humidity was maintained.

Reconstitution consisted of soaking the dehydrated samples at a ratio of one part of the dehydrated product to one-and-one-half parts of water. The dehydrofrozen product was soaked in one part water and both products were cooked under fifteen pounds pressure for a period of five minutes and presented to a taste panel for individual evaluation.

The taste panel was composed of personnel who knew the desirable taste that sweet potatoes should possess. The members of the panel evaluated the samples on a basis of fifty points for general appearance, ten for odor, five for texture, ten for flavor, fifteen for color and ten for firmness. An analysis of individual placings by numbers will be found in the succœeding tables and discussions.

As noted in Table IV, in general appearance samples

varied by a range of forty-five points, the tasters only 9.2 points, a precision of 4.9:1.0. Odor varied 9.2 points between samples, tasters only 2.2 points, a precision of 4.2:1.0, indicating samplers could not determine odor as easily as general appearance. A part of this was nodoubt due to the fact that not all samples tasted the product at the same time.

Samples tested for texture varied by a range of 5.8 points, the tasters only 1.7, indicating samplers could determine with precision of 3.1, much less than could be desired.

Samples tested for flavor varied by a range of 9.1 points, the tasters only 1.7, indicating samplers could determine flavor with a precision of about 5.4:1.0.

Samples tested for color varied by a range of 13 points, tasters only 2.0, indicating a precision of 6.5:1.0 . Color variation was the easiest point to rate.

Samples tested for firmness varied by a range of 9.2 points, the tasters only 3.8, a precision of 2.4:1, indicating samplers were not able to determine the firmness of the product as easily as the other characteristics.

TABLE II.

AN ANALYSIS OF INDIVIDUAL PLACINGS

(A) General Appearance

Sample Number	General Appearance A	B	C	D	E	F	G	Total	Mean
1	20	35	40	30	40	40	-	205	34.1
2	40	40	40	35	42	45	-	250	41.6
3	50	44	48	40	42	47	-	271	45.1
4	5	10	25	29	15	20	-	89	14.8
5	5	10	25	27	10	15	-	92	15.3
6	10	20	30	34	30	30	-	154	25.6
7	30	25	32	35	25	20	-	167	28.0
8	5	25	32	35	25	20	-	142	23.6
9	5	10	20	20	5	15	-	75	17.5
10	50	48	40	40	48	40	-	258	23.0
11	42	20	30	30	18	10	-	150	25.0
12	44	30	35	35	35	15	-	204	38.0
13	38	10	22	32	25	35	-	162	27.0
14	30	10	20	20	18	5	-	113	19.0
15	33	10	25	30	22	30	-	150	25.0
16	35	10	25	20	18	20	-	128	21.3
17	36	20	25	30	15	25	-	151	25.1
18	50	30	38	35	30	40	-	223	37.1
19	-	-	-	-	-	-	-	-	-
20	20	35	16	25	-	-	-	96	24.0
21	45	48	35	35	-	-	-	163	40.7
22	40	40	30	35	-	-	-	145	36.2
23	25	20	20	28	-	-	-	93	23.2
24	30	44	35	32	-	-	-	141	35.2
25	-	20	-	18	-	-	-	38	19.0
26	-	20	-	16	-	-	-	36	18.0
27	35	43	25	40	-	-	-	143	35.8
28	45	40	25	30	44	50	50	284	40.6
29	4	40	35	45	45	45	45	259	37.0
30	50	40	40	40	48	35	40	293	41.9
31	40	30	15	43	40	40	35	243	34.8
32	20	20	10	25	30	30	30	165	23.6
33	30	30	30	38	35	25	25	213	30.4
34	35	25	30	27	35	20	20	192	27.4
35	10	5	-	10	20	5	-	50	10.0
36	35	10	-	20	35	10	-	110	22.0
Total	963	927	906	1157	795	732	245	5648	980.9
Mean	28.3	25.7	28.3	32.1	29.4	27.1	35.0	28.4	27.3

TABLE II.

AN ANALYSIS OF INDIVIDUAL PLACINGS

(B) Odor

Sample Number	Odor A	B	C	D	E	F	G	Total	Mean
1	8	6	5	7	-	8	-	34	6.8
2	-	8	10	8	-	10	-	45	9.0
3	-	7	10	9	-	9	-	45	9.0
4	4	3	8	6	-	-	-	21	4.2
5	6	5	8	4	-	-	-	23	4.6
6	7	7	8	6	-	8	-	46	9.2
7	3	4	-	4	-	3	-	14	2.8
8	-	-	3	5	-	-	-	8	1.6
9	5	3	8	3	-	-	-	19	3.8
10	10	8	6	10	10	-	-	44	7.4
11	7	8	6	5	6	-	-	32	5.3
12	5	2	7	9	5	-	-	28	4.6
13	5	2	6	6	3	4	-	26	4.3
14	5	1	4	-	2	-	-	12	2.0
15	5	5	7	5	4	6	-	32	5.3
16	5	1	5	-	2	-	-	13	2.2
17	5	2	5	-	3	3	-	18	3.0
18	6	7	6	2	3	5	-	29	4.8
19	-	-	-	1	-	-	-	1	0.2
20	5	5	6	-	-	-	-	16	4.0
21	6	10	6	5	-	-	-	27	6.8
22	6	4	3	2	-	-	-	15	3.8
23	5	5	5	-	-	-	-	15	3.8
24	7	8	6	5	-	-	-	26	6.5
25	-	-	-	--	-	-	-	-	---
26	-	4	-	3	-	-	-	7	3.5
27	6	10	5	10	-	-	-	31	7.8
28	7	3	6	5	7	6	10	44	6.3
29	8	2	3	9	8	5	9	44	6.3
30	8	4	9	10	8	4	8	49	7.0
31	8	4	9	10	8	4	8	49	7.0
32	6	3	2	4	5	3	5	28	4.0
33	5	4	6	8	5	10	5	43	6.1
34	5	3	9	6	5	9	3	40	5.7
35	-	1	-	3	5	2	-	11	1.6
36	-	3	-	2	5	1	-	11	1.6
Total	193	143	195	172	92	92	48	946	170.9
Mean	5.5	4.0	5.6	4.8	5.1	3.4	5.3	26.3	4.8

TABLE II.

AN ANALYSIS OF INDIVIDUAL PLACINGS

(C) Texture

Sample Number	Texture A	B	C	D	E	F	G	Total	Mean
1	-	3	5	2	-	7	-	17	4.3
2	-	4	5	4	-	3	-	16	4.0
3	-	4	5	5	-	10	-	24	6.1
4	-	2	5	4	-	-	-	11	2.8
5	-	2	5	4	-	-	-	11	2.8
6	-	2	5	5	-	7	-	19	4.8
7	-	2	2	2	-	3	-	9	2.3
8	-	4	5	5	-	-	-	14	3.5
9	-	3	4	3	-	3	-	13	3.3
10	5	4	4	5	-	5	-	23	4.6
11	3	2	3	5	-	3	-	16	3.2
12	3	3	2	5	-	3	-	16	3.2
13	2	1	2	5	-	3	-	13	2.6
14	2	1	3	5	-	3	-	14	2.8
15	2	0	3	5	-	4	-	14	2.8
16	1	3	3	5	-	3	-	15	3.0
17	2	4	3	5	-	3	-	17	3.4
18	2	0	2	5	-	4	-	13	2.6
19	-	1	-	-	-	-	-	1	0.2
20	-	5	2	2	-	-	-	9	2.3
21	4	5	5	2	-	-	-	16	4.0
22	3	5	5	4	-	-	-	17	4.3
23	4	5	4	4	-	-	-	17	4.3
24	4	5	3	3	-	-	-	15	3.8
25	-	5	-	-	-	-	-	5	2.5
26	-	5	-	-	-	-	-	5	2.5
27	4	5	3	4	-	-	-	16	4.0
28	-	2	5	5	4	-	5	21	3.5
29	-	2	-	5	4	-	-	11	1.8
30	-	1	5	2	2	-	3	13	2.1
31	-	1	3	5	4	-	-	13	2.1
32	-	2	2	3	3	-	3	13	2.1
33	-	4	5	4	3	-	2	18	3.0
34	-	4	3	3	3	-	2	15	2.5
35	-	1	1	1	2	-	0	5	0.8
36	-	2	-	3	1	-	-	6	1.0
Total	41	104	111	135	26	64	15	491	965
Mean	2.3	2.9	3.3	4.0	2.9	3.6	1.7	13.6	2.6

TABLE II.

AN ANALYSIS OF INDIVIDUAL PLACINGS

(D) Flavor

Sample Number	Flavor A	B	C	D	E	F	G	Total	Mean
1	8	5	7	-	-	7	-	27	6.8
2	9	9	9	-	-	8	-	35	8.8
3	10	8	10	-	-	10	-	38	9.5
4	3	2	3	-	-	-	-	8	2.0
5	2	3	5	-	-	-	-	10	2.5
6	5	3	6	-	-	7	-	21	5.3
7	4	3	6	-	-	3	-	16	4.0
8	7	-	4	-	-	-	-	11	2.8
9	6	5	8	-	-	-	-	19	4.8
10	10	7	9	10	10	9	-	55	9.1
11	8	3	7	8	8	4	-	38	6.3
12	7	5	7	7	7	4	-	37	6.1
13	4	1	5	6	4	4	-	24	4.0
14	3	1	5	5	3	3	-	20	3.3
15	1	1	5	4	3	8	-	22	3.7
16	-	1	-	2	3	4	-	10	1.7
17	1	1	2	-	2	3	-	9	1.5
18	5	-	5	5	5	3	-	23	3.8
19	-	-	-	-	-	-	-	-	---
20	5	-	-	5	-	-	-	10	3.3
21	5	5	-	3	-	-	-	13	4.3
22	4	-	6	-	-	-	-	10	3.3
23	8	7	-	7	-	-	-	22	7.4
24	-	-	-	-	-	-	-	-	---
25	-	-	-	-	-	-	-	-	---
26	8	10	9	-	-	-	-	27	9.0
27	6	2	-	6	-	-	-	14	4.7
28	4	3	3	-	9	7	10	36	6.0
29	-	1	-	-	2	5	-	8	1.3
30	5	1	2	-	3	6	8	25	4.2
31	-	1	-	-	4	3	-	8	1.3
32	-	1	-	-	5	4	5	15	2.5
33	5	7	2	-	5	8	5	32	5.3
34	6	6	4	-	5	10	4	35	5.8
35	-	1	-	-	2	1	-	4	0.7
36	-	1	-	-	2	2	-	5	0.8
Total	149	104	114	83	82	123	41	687	145.9
Mean	4.1	2.9	4.2	4.6	4.6	4.6	4.6	19.1	4.1

TABLE II.

AN ANALYSIS OF INDIVIDUAL PLACINGS

(E) Color

Sample Number	Color A	B	C	D	E	F	G	Total	Mean
1	12	10	8	6	-	10	-	46	9.2
2	13	13	15	10	-	12	-	51	10.2
3	15	12	15	12	-	14	-	68	13.6
4	5	8	5	7	-	7	-	32	6.4
5	3	8	4	5	-	8	-	28	5.6
6	7	9	7	8	-	10	-	41	8.2
7	10	8	5	7	-	7	-	30	6.0
8	9	8	7	10	-	10	-	44	8.8
9	2	4	4	4	-	5	-	19	3.8
10	13	12	12	10	15	13	-	75	12.5
11	11	6	9	6	6	6	-	44	7.4
12	11	10	10	8	9	7	-	55	9.1
13	12	5	9	5	7	11	-	50	8.3
14	8	2	4	2	5	5	-	26	4.3
15	8	5	8	4	6	10	-	41	6.9
16	8	6	5	2	6	8	-	35	5.9
17	10	7	8	5	5	9	-	44	7.3
18	15	9	10	7	10	10	-	61	10.1
19	-	-	-	-	-	-	-	-	---
20	5	5	6	12	-	-	-	28	7.0
21	10	15	12	10	-	-	-	47	11.8
22	7	15	11	12	-	-	-	45	11.3
23	6	5	6	8	-	-	-	25	6.2
24	9	14	9	10	0	-	-	42	10.5
25	-	-	-	12	-	-	-	12	3.0
26	-	-	-	-	-	-	-	-	---
27	8	15	8	15	-	-	-	46	11.5
28	12	13	10	10	14	15	15	89	12.7
29	14	13	12	15	13	12	13	92	13.1
30	15	12	11	14	14	13	12	91	13.0
31	13	10	10	13	13	10	9	78	11.1
32	5	5	5	5	10	4	10	44	6.3
33	10	10	9	12	8	9	6	64	9.1
34	8	6	8	7	7	7	7	50	7.1
35	-	2	-	1	5	1	-	19	2.7
36	5	3	-	4	5	3	-	20	2.9
Total	299	330	260	279	158	236	72	1582	272.0
Mean	8.3	9.2	7.2	8.0	8.8	8.7	8.0	44.0	7.6

TABLE II.

AN ANALYSIS OF INDIVIDUAL PLACINGS

(F) Firmness

Sample Number	Firmness A	B	C	D	E	F	G	Total	Mean
1	-	8	10	6	-	8	-	32	8.0
2	-	10	8	-	9	7	-	34	8.5
3	-	7	10	9	-	10	-	36	9.0
4	-	3	10	6	-	8	-	27	6.8
5	-	2	10	7	-	7	-	26	6.5
6	-	1	10	7	-	8	-	26	6.5
7	-	3	10	3	-	9	-	25	6.3
8	-	7	10	9	-	8	-	34	8.5
9	-	7	10	4	-	7	-	28	7.0
10	10	8	10	8	8	9	-	53	8.9
11	8	8	8	10	10	8	-	52	8.7
12	8	8	[illegible]	10	9	7	-	51	8.5
13	2	3	2	10	6	1	-	24	4.0
14	2	3	5	10	4	6	-	30	5.0
15	1	1	7	10	5	7	-	31	5.1
16	1	6	5	10	2	7	-	31	5.1
17	5	1	5	10	4	8	-	33	5.5
18	2	8	7	10	6	7	-	40	6.7
19	-	-	-	-	-	-	-	-	---
20	3	10	4	8	-	-	-	25	6.3
21	5	10	10	9	-	-	-	34	8.5
22	5	10	8	7	-	-	-	30	7.5
23	5	10	5	7	-	-	-	27	6.8
24	5	10	7	6	-	-	-	28	7.0
25	-	10	-	5	-	-	-	15	3.8
26	-	10	-	-	-	-	-	10	2.5
27	5	10	3	10	-	-	-	28	7.0
28	-	8	10	4	-	-	10	32	8.0
29	-	8	10	10	-	-	9	37	9.3
30	-	2	10	4	-	-	8	24	6.0
31	-	4	10	10	-	-	7	31	7.8
32	-	5	10	6	-	-	5	26	6.5
33	-	8	10	8	-	-	5	31	7.8
34	-	6	10	6	-	-	-	22	5.5
35	-	6	10	7	-	-	-	23	5.8
36	-	7	10	7	-	-	-	24	6.0
Total	67	235	273	263	54	134	44	1060	136.7
Mean	3.7	6.5	7.6	7.3	6.0	7.4	4.9	29.4	3.8

DISCUSSION OF RESULTS

The samples were tested following a short period in storage. They were reconstituted, cooked, and individually evaluated by a taste panel. The evaluation was based upon general appearance, odor, texture, flavor, color, and firmness of the product. Fifty points were given for general appearance, ten for odor, five for texture, ten for flavor, fifteen for color, and ten for firmness.

Each series was grouped so as to compare each of two or three of the factors most likely to affect the quality of the product. The prepeeling treatments were compared, one with the other; the two methods of peeling: steam and lye; the two methods of preprocessing: dicing and pulping; and finally the methods of processing: dehydration, dehydrofreezing, and freezing of fresh and cured stock.

When the samples were scored, wide differences in general appearance were found. The fresh frozen samples were superior in appearance to those which were dehydrofrozen. The dehydrated samples were equal or nearly so to the fresh frozen potatoes in this quality factor. Neither curing, the prepeeling method, the peeling method, or preprocessing had any real effect on appearance. In general those samples that were blanched were superior in appearance.

to those that were not blanched.

As indicated in the succeeding table, a difference in odor was found. The frozen samples were superior to those which were dehydrofrozen. Dehydrated samples were equal or nearly so to the frozen product. In general, those samples that were diced were superior in odor to those which were pulped. Those samples that were steam peeled were superior to those which were lye-peeled in this factor. Neither the prepeeling method or curing had any appreciable effect.

When the samples were scored, difference in texture were negligible. Neither curing, prepeeling, peeling, preprocessing, or processing had a real effect on texture.

In scoring the samples, wide differences in flavor were found. The frozen samples were superior to those dehydrofrozen or dehydrated. Those samples that were uncured were superior in flavor to those which were cured. The prepeeling method had no effect upon flavor. The steam peeling method was superior to those which were lye peeled in this quality factor. Those samples that were diced were superior in flavor to those which were pulped.

When the samples were scored, side differences were found in color. The samples that were frozen were superior in color to those which were dehydrofrozen. The dehydrated samples were equal or nearly so, to the frozen product. The steam peeled product was superior in color, to those which

TABLE III.

SAMPLES AND METHODS OF TREATMENT

No.	Curing	Pre-peel.	Peel.	Pre-process.	Blanching	Processing
1	None	None	Steam	Diced	None	1
2	do	do	do	do	do	2
3	do	do	do	do	do	3
4	do	do	do	Pulped	do	1
5	do	do	do	do	do	2
6	do	do	do	do	do	3
28	do	do	Lye	Diced	Yes[2]	1
29	do	do	do	do	do	2
30	do	do	do	do	do	3
31	do	Yes[1]	do	do	None	1
32	do	do	do	do	do	2
33	do	do	do	do	do	3
7	do	do	do	Pulped	do	1
8	do	do	do	do	do	2
9	do	do	do	do	do	3
34	do	do	do	do	do	1
35	do	do	do	do	do	2
36	do	do	do	do	do	3
10	Cured	None	Steam	Diced	do	1
11	do	do	do	do	do	2
12	do	do	do	do	do	3
25	do	do	DO	Pulped	do	1
26	do	do	do	do	do	2
27	do	do	do	do	do	3
13	do	do	Lye	Diced	yes[2]	1
14	do	do	do	do	do	2
15	do	do	do	do	do	3
19	do	do	do	Pulped	do	1
20	do	do	do	do	do	2
21	do	do	do	do	do	3
16	do	Yes[1]	do	Diced	None	1
17	do	do	do	do	do	2
18	do	do	do	do	do	3
22	do	do	do	Pulped	do	1
23	do	do	do	do	do	2
24	do	do	do	do	do	3

1. Heated to 122° F. for 30 minutes 2. Blannhed for 7 min at 212° F.

1, 2, and 3 in the last column (processing) stand for frozen, dehydrofrozen, and dehydrated, respectively.

were lye peeled. Those samples which were diced were superior in color to those which were pulped. Neither curing or the prepeeling method had any real effect on color.

In scoring the samples, some difference in firmness was observed. In general those samples which were frozen were superior to those which were dehydrofrozen or dehydrated. Neither blanching, the preprocessing method, or prepeeling had any ral effect upon firmness. Those samples which were uncured were superior in firmness to those which were cured. Cutting in cubes had no appreciable effect upon firmness, but pulping altered the natural firmness of the product.

Although cured and uncured sweet potatoes were used for this experiment, there was no significant difference between the two methods, as indicated by Table VI. There was an increase in sweetness of the cured product and it was more difficult to lye peel due to an increase in epidermal cells.

An effort was made to prevent discoloration of tissue by inactivation of oxidation enzymes. Whole potatoes were heated in a water bath at a temperature of 122 degrees F. for thirty minutes. Each batch was compared to an unheated control. No preheating before peeling resulted in a product superior in quality to those preheated by an increase of

TABLE IV.

SCORE CHART OF THE SAMPLES

Appearance	Odor	Texture	Flavor	Color	Firmness	Total
41.0	7.6	4.6	8.0	10.0	8.4	79.6
42.3	6.6	2.8	1.0	10.2	7.2	70.1
35.5	5.5	4.4	4.3	11.3	6.0	67.0
14.8	3.5	1.8	1.3	5.3	4.5	31.4
15.3	3.8	1.8	1.6	4.6	4.3	31.4
25.6	7.6	3.2	3.5	6.3	4.3	51.0
47.6	9.8	5.2	8.8	14.2	9.4	95.0
37.0	6.3	1.6	1.1	13.2	5.3	64.5
41.9	7.0	1.9	3.6	13.0	2.0	69.3
42.4	8.2	5.4	8.0	11.2	8.6	83.6
23.6	4.0	1,9	2.1	6.3	3.7	41.6
30.4	6.1	2.6	4.6	9.1	4.4	57.2
27.8	2.3	1.5	2.6	5.0	4.1	43.1
23.6	1.3	2.3	1.8	7.3	5.6	41.9
12.5	3.2	2.1	3.1	3.1	4.6	28.6
27.4	5.7	2.3	5.0	7.1	3.1	50.4
7.1	1.6	0.7	0.6	1.3	3.3	14.6
15.7	1.6	0.9	0.7	3.0	3.4	25.3
33.6	7.4	3.8	5.4	7.2	7.8	65.2
25.0	5.3	2.6	6.3	7.3	8.6	55.1
34.0	4.6	2.6	6.1	9.1	8.5	69.9
26.8	5.6	2.8	1.0	5.0	6.8	48.0
9.0	1.7	1.2	6.5	0.0	2.5	20.9
35.7	7.5	4.0	3.5	11.5	7.0	69.2
27.0	4.3	2.1	4.0	8.3	4.0	49.7
18.8	2.0	2.3	3.3	4.3	5.0	35.7
25.0	5.3	2.3	3.5	6.8	5.1	48.0
33.6	6.2	3.8	4.2	6.8	7.8	62.4
21.5	4.0	2.5	2.5	7.0	6.2	43.7
40.8	6.7	4.0	3.2	11.7	8.5	74.9
38.4	5.6	4.2	5.0	8.8	8.2	70.2
25.1	3.0	2.8	1.5	7.3	5.5	45.2
37.1	4.8	2.1	3.2	10.1	6.6	64.5
36.2	3.5	4.2	2.5	11.2	7.5	65.1
23.2	3.5	4.2	5.5	6.2	6.7	49.3
35.2	6.5	3.7	0.0	10.5	7.8	62.9

twenty-three per cent. The preheated product retained desirable characteristics throughout processing, but when reconstituted and cooked it oxidized very rapidly. The different samples tasted had an odor of sour potatoes, green sawdust, and sometimes a haylike odor was present. The longer the samples had been exposed to the air, the more obnoxious the odor and flavor became. These results do not agree with Woodroof (30), who preheated potato slices with excellent results. The discoloration after cooking was apparently due to the fact that insufficient heat penetration of tissue during preheating failed to inactivate the oxidation enzymes throughout the potatoes. A higher temperature is apparently needed for successful preheating of whole sweet potatoes.

Two methods of peeling were compared. Steam peeling was compared to lye peeling with both cured and uncured sweet potatoes. The samples tested indicate that steam peeling definitely resulted in a superior product by a forty per cent increase. The steam peeled potatoes resulted in a considerable loss of edible material. The product retained its natural characteristics throughout processing, reconstitution, and cooking. It did not oxidize severely upon reaching the air which was apparently due to the fact that adequate heat penetration of tissue prevented oxidation and discoloration. Woodroof (32) did similar work with steam peeling which agrees with the above results.

The use of lye for peeling gave excellent results during the peeling process, but resulted in an inferior product when processed, reconstituted, and cooked. A ten percent lye solution was used at a temperature of 212 degrees F. for peeling with a minimum loss of edible material. Potatoes with rough veins were peeled as easily as smooth potatoes. Discoloration of the tissue was rapid during processing, reconstituting and cooking. This was apparently due to inadequate heat penetration during the peeling process. The processed, reconstituted, and cooked products had a sour, sawdust-like flavor and odor. The longer the samples were exposed to air after cooking the more obnoxious was the odor and flavor. This does not agree with previous work done with lye peeling (23, 24), even though the same temperature was used. A longer period of heating at this temperature is apparently needed for sufficient heat penetration of the tissue.

The preprocessing methods of dicing and pulping were compared. A significant difference between the two resulted in a product superior in quality to pulping by a 50% increase. The diced product was easily blanched with sufficient penetration of heat to prevent discoloration. The diced pieces did not adhere, therefore, heat penetration and dehydration was uniform. The pieces retained their natural characteristics throughout the tests.

Pulping resulted in an inferior product due to exposure of a large surface area to oxidation by the incorporation of excess air into the tissue. The particles adhered making heat penetration of the tissue more difficult. An incomplete sterilization and inactivation of the oxidation enzyme resulted. The product had a sour odor and flavor when dehydrated, reconstituted, and cooked. The longer the product was exposed to air, the more disagreeable was the color, odor, and flavor.

Samples that were not preheated before peeling were blanched at a temperature of 212 degrees F. for seven minutes. Those steam peeled and preheated were not blanched. The unblanched samples resulted in a product superior in quality to blanching by a thirty per cent increase. The unblanched product did not severely oxidase when processed reconstituted, and cooked. This is apparently due to the fact that there was adequate heat penetration of tissue during steam peeling which prevented discoloration. This does not agree with previous work done on blanching. The potatoes with which research was done were not steam peeled.

Three methods of processing - freezing, dehydrofreezing, and dehydrating were compared in this study. There was little difference in quality when the potatoes were frozen without further treatment and when they were dried. Exceptions to this case were found in odor and flavor of some samples which was apparently due to

the fact that they were lye peeled and pulped. Woodroof and Foster (30, 11) did similar studies which agree with these results.

When freezing and dehydrofreezing are compared it may be seen that almost none of the dehydrated samples approached the quality of those frozen. When all samples are compared those frozen without drying scored 40 per cent better than those partially dried before freezing. This was due to the fact that immediate freezing of the product helped prevent oxidation and discoloration. The dehydrofrozen product had a sour, objectionable odor during dehydrating, reconstitution, and cooking. When samples were exposed to the air for short periods of time discoloration became evident. Since no work has been done with dehydrofreezing sweet potatoes in the past, there were no previous results to compare with the above findings.

TABLE V

A COMPARISON OF NONCURED AND CURED POTATOES

Treatment	Appearance	Odor	Texture	Flavor	Color	Firmness	Total
Noncured	498.8	85.5	29.2	51.4	132.6	106.3	905.8
Cured	467.4	73.3	48.3	72.3	136.3	79.5	877.1

TABLE VI

A COMPARISON OF PREHEATING AND NO PREHEATING BEFORE PEELING

Treatment	Appearance	Odor	Texture	Flavor	Color	Firmness	Total
No preheat	452.2	81.5	38.8	64.3	127.4	82.0	846.2
Preheated	381.5	54.8	35.7	35.9	104.1	75.0	686.0

TABLE VII

A COMPARISON OF PEELING METHODS

Treatment	Appearanee	Odor	Texture	Flavor	Color	Firmness	Total
Steam	422.7	61.9	32.0	54.5	87.5	69.1	727.7
LYe	285.7	45.0	25.7	31.8	83.0	55.6	526.8

TABLE VIII.

A COMPARISON OF PREPROCESSING METHODS

Treatment	Appearance	Odor	Texture	Flavor	Color	Firmness	Total
Diced	585.3	94.6	46.1	72.8	167.3	99.5	1065.6
Pulped	380.9	64.2	41.8	40.9	104.6	86.3	718.7

TABLE IX.

A COMPARISON OF BLANCHING AND NON-BLANCHING

Treatment	Appearance	Odor	Texture	Flavor	Color	Firmness	Total
Blanch.	152.6	52.1	20.2	26.3	80.0	41.7	372.9
No Blanch	265.2	51.2	23.0	31.0	70.6	42.5	483.5

TABLE X

A COMPARISON OF PROCESSING METHODS

Treatment	Appearance	Odor	Texture	Flavor	Color	Firmness	Total
Frozen	396.4	69.4	41.1	55.8	100.1	80.2	743.3
Dehy'fr.	271.5	43.1	26.7	33.8	75.0	63.9	514.0
Dehydr.	369.4	66.4	33.8	39.3	105.5	68.2	682.6

SUMMARY

Recent years have witnessed phenomenal expansion of the food dehydration and freezing industries. Preliminary experiments with several fruits and vegetables have shown that moderate dehydration, removal of about two-thirds of the water content followed by freezing resulted in excellent products in many cases.

The purpose of this experiment was to determine if sweet potatoes could be dehydrofrozen successfully. To accomplish this, the dehydrofrozen product was compared to conventional methods of preservation, freezing, and dehydrating. The comparisons included: (a) cured and uncured stock; (b) steam and lye peeling; (c) preheating and no preheating; (d) the preprocessing methods of dicing and pulping and (e) blanching and no blanching.

In general, there was no significant difference between cured and uncured potatoes, as judged by the taste panel.

No preheating before peeling gave a product superior in quality to preheating by an increase of 23 per cent. The product retained its natural color characteristics throughout processing. Discoloration was not prevented by preheating. The preheated product retained its desirable characteristics during processing but when reconstituted and cooked,

oxidation was rapid. The heat necessary for preheating caused excess discoloration and did not inactivate oxidation enzymes. A higher temperature for a longer time may be necessary for whole potatoes. Samples not preheated, but steam peeled or blanched after peeling, retained their natural color during dehydrating and freezing.

Steam peeling resulted in a product superior in quality to lye peeling by an increase of forty per cent. This treatment gave a uniformly peeled product that did not oxidize easily. This was apparently due to the fact that a greater heat penetration of tissue occurred which inactivated the oxidation enzymes and sterilized the product. There was a considerable loss of edible tissue.

The use of a ten per cent lye solution gave excellent results during the peeling process but resulted in a product that oxidized rapidly when processed, reconstituted, and cooked. Rough potatoes were peeled as easily as smooth stock. A longer period of preheating is apparently needed to adequately heat the potato tissue before peeling.

Dicing as a method of preprocessing, gave a product superior in quality to pulping by an increase of fifty per cent. The diced particles had a reduced surface area, therefore, oxidation of tissue was retarded. The pulped product adhered making it difficult to blanch, for heat penetration and for sterilization. Pulping, incorporated air into the

tissue and increased the surface area of particles resulting in excess discoloration.

No blanching gave a product superior in quality to blanching by an increse of thirty per cent. This was due to the fact that these samples were either preheated or steam peeled, as indicated in Table V.

Of the three methods of processing, freezing resulted in a product superior in quality to dehydrating by an increase of ten per cent. Exceptions were due to lye peeling and pulping which resulted in difinite discoloration of tissue. Freezing was superior to dehydrofreezing by an increase of forty per cent. The dehydrofrozen and dehydrated products showed undesirable flavor and odor characteristics which may have been due to heat required for dehydration. Freezing the product immediately helped prevent oxidation and discoloration of the product. With an increase in the number of treatments per sample, a marked decrease in quality resulted.

Although dehydrofreezing resulted in a product inferior to freezing and dehydrating, there are definite possibilities that the process may be successful provided a method for preventing discoloration could be worked out by further study. Dicing and steam peeling gave promising results when the product was dehydrofrozen.

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APPENDIX

APPENDIX

SAMPLES AND TREATMENTS RECEIVED

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Sample Number	Prepeeling Treatment	Method of Peeling	Mehod of Preprocessing	Method of Processing
1	None	Steam	Diced	Frozen-Raw
2	do	do	do	Dehydrofrozen
3	do	do	do	Dehydrated
4	do	do	Pulped	Frozen-Raw
5	do	do	do	Dehydrofrozen
6	do	do	do	Dehydrated
7	Preheated	Lye	Pulped	Frozen-Raw
8	do	do	do	Dehydrofrozen
9	do	do	do	Dehydrated
10	None	Steam	Diced	Frozen-Raw
11	do	do	do	Dehydrofrozen
12	do	do	do	Dehydrated
13	do	Lye	diced-blanched	Frozen-Raw
14	do	do	do	Dehydrofrozen
15	do	do	do	Dehydrated
16	Preheated	do	Diced	Frozen-Raw
17	do	do	do	Dehydrofrozen
18	do	do	do	Dehydrated
19	None	do	pulped-blanched	Frozen-Raw
20	do	do	do	Dehydrofrozen
21	do	do	do	Dehydrated
22	Preheated	do	Pulped	Frozen-Raw
23	do	do	do	Dehydrofrozen
24	do	do	do	Dehydrated
25	None	Steam	do	Frozen-Raw
26	do	do	do	Dehydrofrozen
27	do	do	do	Dehydrated
28	do	Lye	diced-blanched	Frozen-Raw
29	do	do	do	Dehydrofrozen
30	do	do	do	Dehydrated
31	Preheated	do	Diced	Frozen-Raw
32	do	do	do	Dehydrofrozen
33	do	do	do	Dehydrated
34	do	do	Pulped	Frozen-Raw
35	do	do	do	Dehydrofrozen
36	do	do	do	Dehydrated