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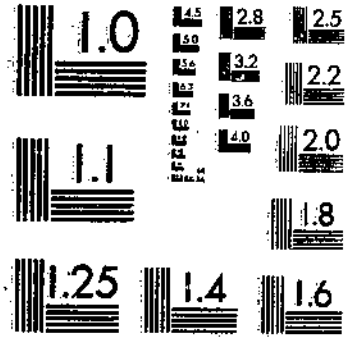
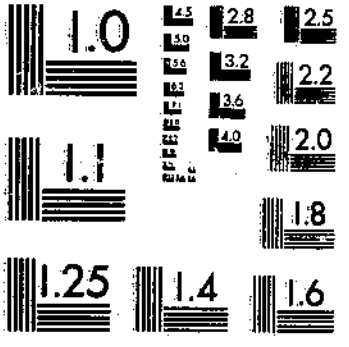


MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A



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THE COOKING QUALITY, PALATABILITY, AND CARBOHYDRATE COMPOSITION OF POTATOES AS INFLUENCED BY STORAGE TEMPERATURE

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INTRODUCTION

The effect of storage temperature on the cooking quality and palatability of potatoes has received considerable attention recently. This interest has been stimulated mostly by demands of restaurant operators and potato-chip manufacturers for potato supplies that will more suitably and uniformly satisfy their particular needs. With the increasing consumption of potato chips, manufacturers have experienced greater difficulty in obtaining sufficient quantities of stock uniformly suitable for making a high-quality product the year around. These manufacturers have found by experience that they can seldom depend on stock grown in the extreme northern potato-producing area and handled in the usual way, to produce, for more than 2 or 3 weeks following harvest, the product that their market demands. After this time they must draw on stock grown and stored in the intermediately located States, until the early southern-grown supply becomes available.

Many restaurants in late winter usually find it extremely difficult to obtain stocks from which they can prepare a uniformly good quality of French fried or baked potatoes. The usual objection to these northern-grown potatoes, and often to the stock grown in the intermediate States, is that when made into chips or French fries during the winter the product is often dark brown in color, instead of the light golden yellow demanded by consumers. An apparently

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unbalanced economic situation is thus presented in which chip manufacturers, and to some extent certain restaurateurs, located in or near these extensive potato-producing sections are of necessity avoiding the use of enormous quantities of potatoes stored nearby and are purchasing their stock from a distance.

DISCUSSION AND REVIEW OF LITERATURE

Sweetman (*7*)[1] demonstrated in 1930 that chips made from tubers stored between 32° and 37° F. were darker in color than those made from stock stored between temperatures of 40° and 55°. In 1931 in a preliminary report the writers (*5*) showed that the color of potato chips was most desirable when made from tubers stored at 60° or 70°, and the brown color of the chips became more and more intensified as the storage temperature decreased. Chips made from potatoes stored at 40°, 36°, and 32° were not edible.

That the sugar content of potatoes increases when they are stored at comparatively low temperatures has been known for many years. This fact was reported in 1882 by Müller-Thurgau (*3*) and later substantiated by the results of Appleman (*1*). In 1932 Wright (*8*) reported the results of periodic analyses of potatoes in storage at temperatures ranging from 32° to 70° F. He found a slight increase in the sugar content of potatoes stored at 40°, but at temperatures below this the increase in sugar was quite marked. At temperatures above 40° there was shown a tendency for the amount of sugar to remain as it was just after harvest or to decrease somewhat as the storage temperature was increased to 70°.

Since it has been demonstrated that the sugar content of potatoes increases progressively at storage temperatures of 40°, 36°, and 32° F. and that the cooking qualities of potatoes stored at these temperatures compare unfavorably with those stored at higher temperatures, it is apparent that northern-grown potatoes become unsuitable for certain purposes because of the relatively low temperatures naturally maintained throughout the winter months in the usual type of storage houses. The mean weekly temperatures during 24 weeks of storage in two commercial bank-storage places and in a barn-basement storage in New York State, as reported by Smith (*6*), were 37.5°, 38.8°, and 40.6°, respectively. That these temperatures are too low to maintain the highest cooking quality in potatoes will be demonstrated in this report. Many thousands of bushels of potatoes are grown and stored north of the latitude where the records reported by Smith were taken in New York State, and in those sections the average temperatures of most storage houses would undoubtedly range from about 37° to 34°.

It is common knowledge among scientific workers that potatoes which have become sweet from low-temperature storage will lose a certain amount of their surplus sugar content if later held at a relatively high storage temperature for 2 or 3 weeks. The rapidity with which the sugar content may decrease was shown by Wright (*8*) when potatoes were moved from 32° storage to 60° F. Since oversweet potatoes will largely recover when kept for a suitable period at a relatively high temperature (60° to 70°) it should be emphasized here that potatoes from northern sections should not be condemned or refused when they have become oversweet, because in most instances

[1] Italic numbers in parentheses refer to Literature Cited, p. 20.

they will make fair-quality products if properly handled. Furthermore, it would seem to be advantageous for northern growers to store at least a part of their table stock at temperatures likely to retain the maximum palatability.

At this point the writers wish to emphasize the fact that it has been shown by Wright and Peacock (*9*) that at storage temperatures at which the cooking quality of potatoes is most desirable their natural rest period is shorter and sprouting takes place sooner. For this reason the practical storage-house manager should endeavor to keep the temperature of the bulk of the potatoes at the higher limit at which prolonged dormancy can be maintained (*9*), while holding a suitable quantity for immediate needs at optimum temperatures for best cooking quality if he wishes to cater to this special trade.

INVESTIGATIONAL PROCEDURE

With the above-mentioned problems in mind the writers began an investigation to determine the effects of different storage temperatures upon the cooking quality and palatability of potatoes. This work was mostly carried on as a cooperative project between the Bureau of Plant Industry and the Bureau of Home Economics. The former Bureau assumed all responsibility and furnished all facilities for the growing, harvesting, and storing of the potatoes to be studied, and made all chemical analyses, while the latter Bureau furnished the facilities for cooking and conducted the cooking tests described. These tests included baking, boiling, steaming, chip making, and French frying various lots of potatoes and carefully judging the resultant products as to flavor, appearance, and other important characteristics. In the last lot of potatoes to be studied, periodic samples were taken for carbohydrate analyses.

These investigations were started in 1929 and were continued through the season of 1931–32. All of the potatoes used were grown on a medium loam soil on the Arlington Experiment Farm, near Washington, D. C. Each crop was fertilized, cultivated, and sprayed to produce a normal yield of high-class table stock. In each instance after harvest the potatoes were taken directly to the cold-storage laboratory, located on the same farm, and allowed to stand in bushel baskets in the workroom in temperatures ranging from 60° to 70° F. for 4 or 5 days, to allow the skins to dry and set more firmly.

After this preliminary curing period the tubers were carefully selected and graded into one lot of uniformly shaped, medium-sized specimens weighing from 7 to 9 ounces each. These were then apportioned into individual bushel-basket lots, care being taken to obtain uniformity in the contents of each basket. The baskets were then put into storage at the various controlled temperatures, with humidities adjusted to afford at each temperature the same saturation deficit, or, in other words, the same evaporating efficiency.

INVESTIGATIONS IN 1929

PRELIMINARY COOKING TEST

In 1929 an early-planted crop of Irish Cobbler potatoes was harvested August 3 and samples stored August 7 at 32°, 36°, 40°, 50°, 60°, and 70° F. On October 7, after 8 weeks of storage, the first

samples, consisting of six specimens from each storage condition, were selected for a cooking test.

After being washed, a few of the raw potatoes from 36° and 32° F. storages were tasted; it was noted at this time that these were noticeably sweet and probably objectionable on this account. The lots from the different temperatures were then put into individual cloth bags in a large boiler, all of the potatoes being steamed at one time until well done, or for about 30 minutes.

The judging of these for quality was done by five disinterested members of the laboratory group who individually examined and tasted each lot while it was still hot and neither salted nor flavored in any way. Without knowing the identity of the lots the judges unanimously favored the samples from both the 60° and the 70° F. storage as being better in flavor and texture than those from the lower temperatures, most of them expressing a preference, however, for the lot from the 60° storage. A summary of these results is presented in table 1.

TABLE 1.—*Condition of Irish Cobbler potatoes, steamed after storage for 8 weeks at given temperatures*

Items of comparison	Condition after storage at temperature of—					
	70° F.	60° F.	50° F.	40° F.	36° F.	32° F.
Flavor	Good, desirable.	Very good, desirable.	Good, desirable.	Fair, slightly sweet.	Poor, sweet.	Poor, sweet.
Texture	Mealy	Mealy	Mealy	Slightly soggy.	Soggy, wet.	Soggy, wet.
Color	Creamy white.	Creamy white.	Creamy white.	Slightly yellow.	Yellow	Yellow.

The potatoes from the 50° F. storage were thought to be almost as desirable as those from the 60° or 70° storage, whereas those from the 40° storage if tasted first seemed to be satisfactory, but if tasted immediately after those from the 60° or 70° storage a slightly sweet flavor was noticeable. On the other hand, the tubers from the 36° and the 32° storage were distinctly sweet and for this reason unpalatable. The tubers from storage temperatures of 50° and above were mealy, with no suggestion of sogginess, and of a pleasing creamy-white color, whereas those from the 40° storage were less mealy, slightly watery in texture, and slightly more yellow in color. In those from the 36° and the 32° storage there was a decidedly soggy or watery texture with a pronounced yellow color.

At the end of 12 weeks and again after 16 weeks of storage similar cooking tests were made on tubers from these same general lots. The results were practically the same as reported for the earlier examinations, showing little change in relationships during longer periods of storage and also confirming the results of the first test.

After the 12 weeks' storage period, sample lots were moved from 60° and 70° F. storage to 40° for 4 weeks and then cooked with others that had remained continuously in storage at 40° for 16 weeks. When cooked the samples seemed to be identical in flavor with those from the 16-week continuous 40° storage, although they remained practically the same in color and texture as in the original storage temperature.

COOPERATIVE COOKING TESTS

Following the significant and interesting results as reported on the early-planted crop in 1929, it was decided to carry on further tests in greater detail, and it was at this time that the cooperation of the Bureau of Home Economics was invited. As a result, the following carefully controlled cooking tests were started January 22, 1930, on two late-planted varieties of potatoes that had been in storage at several temperatures since November 18, 1929, a period of 65 days. The varieties used in these tests were the Green Mountain and Dakota Red. The 32° storage was omitted in the next series of tests, while the other storage temperatures remained the same.

METHODS OF COOKING

The cooking tests included baking, boiling, French frying, and chip making, using in each instance a sample consisting of five tubers. With all methods of cooking the potatoes were unsalted. Before baking, the potatoes were washed thoroughly and dried. Thermometers were inserted to the center of one potato in each lot, and each of the lots was baked in an uninsulated gas-heated oven maintained at a temperature of 392° F. until the internal tuber temperature had reached 212°. For the boiling tests the tubers were not pared, and each lot was placed in a separate utensil, covered with water, and cooked until the tubers reached an internal temperature of approximately 205°, which required about 35 minutes. This temperature was determined by means of a thermometer which extended through a cork stopper in the lid to the center of one tuber in each utensil.

For French frying, pared tubers from each lot were cut into nearly uniform rectangular pieces, approximately ⅜ by ⅜ by 1¾ inches. These pieces were fried, in quantities of 150 g, in a constant amount of high-grade cottonseed oil, which was previously heated to 412° F. The time taken for cooking is discussed on page 8. When making chips the tubers were pared and sliced on a vegetable slicer to a uniform thickness of one-sixteenth of an inch. The slices were then rinsed in cold water for a few minutes to remove the excess starch, and dried between towels; 100 g were then transferred to a constant amount of vegetable oil, preheated to a temperature of 412°. When the slices were put into the fat the temperature dropped to about 366°. The chips were kept in motion with a long-handled fork during the frying. The cooking time is discussed on page 8.

METHOD OF JUDGING

After cooking, all products were judged for quality by a committee of 5 or 6, who in most instances were uninformed of the storage history of the samples they were judging. With the exception of chips, all products were judged while hot. Each potato of the baked and boiled lots was cut in half; one-half of each tuber was judged for color and texture and the remaining halves of each lot were peeled, riced together, and the composite was judged, without added salt, while hot, for flavor and quality of the mashed flesh. Each judge recorded his opinion independently on a score card prepared for the purpose.

RESULTS

As in the preliminary tests, the same relation of palatability to previous storage temperature was evident with all of the methods of cooking; also practically no difference between varieties with respect to the influence of storage temperature on flavor was indicated. In general, potatoes from storage at 40° F. were considered as only fair in quality when cooked, and those from the temperatures below this were poor; those from storage at 50° were classed as good, those from 60° very good, and those from 70° good. The baked and boiled products from potatoes stored at 40° were slightly sweet and watery and also somewhat yellow in color; from 36° storage they were undesirably sweet, inclined to be soggy or watery, and distinctly yellow in color. From the potatoes stored at 50°, 60°, and 70° the cooked products possessed no undesirable sweet flavor, the color was creamy white, and the texture was mealy. Considering all of the lots the potatoes from 60° storage were judged as possessing the most agreeable and desirable flavor.

In making chips and French fries it was found that owing perhaps to their higher sugar content potatoes from storage at 36° F. after being put into the hot oil very quickly turned brown and then almost black around the edges or outsides of the pieces. If removed at this time the interior area was found to be raw or only partly cooked. Preliminary tests on these potatoes cooked in oil at several lower temperatures also proved unsuccessful. To some extent this was also true of the material from storage at 40°. As the storage temperature was increased the time required for cooking to the desired texture also increased. French fries made from potatoes that had been stored at 60° and 70° cooked to an attractive light golden-brown color and a desirable mealy texture; chips made from the same material were of the uniform light creamy-yellow color that is usually preferred by consumers and of a delicate crisp texture and good flavor. When made from potatoes stored at 50°, both chips and French fries had a flavor equally as desirable as those made from potatoes stored at 60° or 70°, but the color was inclined to be darker and not uniform.

From the tubers stored at 40° the chips had to be cooked to a rather dark and unattractive color around the edges in order to get the centers crisp. These chips were classed as poor and were not palatable because of the burned taste. French fries from these potatoes stored at 40° turned dark on the surface before the interiors were well cooked and for this reason were not desirable.

Potatoes stored at 36° F. could not be made into edible chips or French fries, since the outsides of the individual pieces turned very dark while the centers were still raw or only partly cooked, or when the centers were sufficiently cooked the outsides were burned to a black crisp. In table 2 is shown the time required to cook French fries and chips to the best condition in cooking oil heated to 412°. The potatoes used were from representative lots of Irish Cobblers, stored at the different temperatures. A brief description of the resultant cooked products is also given. No varietal differences were noted.

TABLE 2.—*Time required for cooking, and condition recorded in cooking French fries and chips made from Irish Cobbler potatoes stored for 65 days at given temperatures*

[Initial temperature of cooking oil, 412° F.]

Previous storage temperature (°F.)	French fries			Chips		
	Cooking time		Condition	Cooking time		Condition
	Minutes	*Seconds*		*Minutes*	*Seconds*	
70	3	50	Light golden yellow, flavor very good, not oily.	2	23	Uniform light golden yellow, texture and flavor very good, not oily.
60	2	40	do	1	42	Do.
50	1	46	Light brown, not sweet, slightly oily.	1	27	Somewhat spotted, light brown, slightly oily.
40	1	7	Medium brown, somewhat sweet, oily.	1	1	Generally spotted, edges brown, centers flabby, oily.
36	1	0	Dark brown, flabby, not cooked through, sweet, oily.	1	49	Generally spotted, very dark brown on edges, centers raw, oily.

After 65 days a quantity of tubers stored at 36° and 40° F. were transferred to 60° storage for 2 weeks. At the end of this time they were cooked by the methods already described. Little change was noted in the quality of the cooked products of these potatoes as compared with those kept constantly at the original storage temperatures, indicating that perhaps a longer time at the higher temperature would have been necessary to attain the more desirable flavor characteristic of potatoes which had been stored continuously in 60° temperature.

INVESTIGATIONS IN 1931

No investigations were carried on in 1930 because of the severe drought of that year and the consequent total failure at Arlington Farm of the crop of potatoes that was to have been used for this study.

The growing season of 1931 proved to be favorable for the production of a normal crop of good-quality potatoes. Four varieties—Irish Cobbler, Green Mountain, Russet Burbank, and Katahdin—were studied this season. They were harvested November 13 when practically matured and just after the tops had been killed by the first severe frost. After digging, the tubers were set aside in the workroom to dry off and to allow the skins to become firmly set and all abrasions to heal over. On November 23 they were carefully hand-sorted and graded into lots of uniform size and stored at temperatures of 32°, 36°, 40°, 50°, and 60° F.

COOKING TESTS

On March 28, after 124 days in storage, representative samples of each variety were taken for cooking tests. The tests this season consisted in steaming, French frying, and chip making, using 20 tubers for each test. Baking and boiling tests were not made, since previous tests showed that steaming was more easily accomplished and brought out the differences in color and flavor, due to different storage temperatures.

During steaming, the tubers were supported on perforated metal racks above the water level in kettles with lids fitted with stoppers

through which thermometers were inserted to the center of one potato in each kettle. The potatoes were cooked until the internal temperature reached 205° F. Each sample of 20 tubers was cooked in a separate utensil. For French frying the tubers were cut into pieces as previously described (p. 5) and were fried in high-grade cottonseed oil kept at a temperature of 410° for a uniform period of 3 minutes and 30 seconds. For chip making the slices were cut as before described (p. 5) and cooked for a period of 1 minute and 20 seconds in high-grade cottonseed oil, heated to a temperature of 378°, which dropped to about 364° when the slices were put into it. The period set for cooking both the French fries and chips was determined as the optimum for cooking these products from tubers stored at 60°, which had proved in previous years to be the storage temperature from which the best-cooked products were obtained. By using these uniform cooking periods a direct comparison could be made of the products from the different storage temperatures.

METHODS OF JUDGING

In judging the cooked products, 4 or 5 judges in addition to the writers were usually present. The quality of the products was scored as previously described (p. 5).

After steaming, the individual specimens of each lot were judged for table quality, as before described (p. 5). The results with each variety from each storage temperature, as given in table 3, substantiated those obtained from previous tests, and little difference was noted in comparable data from the different varieties. Here, as before, the best quality, as indicated by a mealy texture and desirable flavor free from any trace of sweetness, was found in tubers stored at 50° and at 60° F., whereas in tubers from storage temperatures below 50° there was a general increase in wateriness and sweetness as the storage temperature decreased.

TABLE 3.—*Condition of Irish Cobbler, Green Mountain, Russet Burbank, and Katahdin potatoes, steamed, after 124 days' continuous storage at given temperatures*

Variety	Storage temperature	Flesh when mashed			General quality
		Texture	Color [1]	Flavor	
	°F.				
Irish Cobbler	60	Mealy	10-E-1	Desirable	Very good.
	50	do	10-D-1	do	Do.
	40	Slightly soggy	10-E-1	Slightly sweet	Fair.
	38	Soggy	10-G-1	Very sweet	Poor.
	32	Very soggy	10-H-1	do	Very poor.
Green Mountain	60	Mealy	10-B-1	Desirable	Very good
	50	do	10-C-1	do	Do.
	40	Waxy	do	Slightly sweet	Fair.
	38	Moderately soggy	10-E-1	Moderately sweet	Poor.
	32	Very soggy	9-J-1	Very sweet	Very poor.
Russet Burbank	60	Mealy	10-B-1	Desirable	Very good.
	50	do	do	do	Do.
	40	do	10-E-1	Slightly sweet	Fair.
	38	Soggy	10-G-1	Moderately sweet	Poor.
	32	Very soggy	11-E-1	Very sweet	Very poor.
Katahdin	60	Mealy	do	Strong	Fair.
	50	Moderately mealy	11-F-1	Fair, slightly strong	Do.
	40	Slightly soggy	11-H-1	Slightly sweet, slightly strong.	Poor.
	36	Very soggy	11-J-2	Very sweet, slightly strong.	Very poor.
	32	do	11-K-1	Very sweet	Do.

[1] Designations refer to color charts in Maerz and Paul (2). The first number indicates the plate number and the letter and the succeeding number the location of the color on the plate.

In addition to texture and flavor indicated in table 3, the characteristic colors of the steamed products of Irish Cobbler and Green Mountain potatoes from storage at the various temperatures are also recorded. These color records were obtained by matching the colors of the various cooked samples with the color charts published by Maerz and Paul (*2*). In general, these color records showed a graduation from a pale creamy-gray shade in the samples from 60° storage to a dirty sulphur-yellow tint in those from 32° storage. From the 36° and 32° storage the cooked samples in some instances showed a trace of gray, giving a general grayish-yellow effect. It will be of added interest to record here that in this and previous tests there was noted an increased wateriness and brittleness in texture in uncooked potatoes from 32° and 36° storage. These tubers were also more yellow in tissue color and distinctly sweeter in taste than those from higher storage temperatures.

The results from the judging of French fries and chips are assembled in table 4, and in general they were similar to those of previous tests. In both the French fries and chips there was shown a general tendency for the color to change from an attractive light golden yellow in those from the 60° and 50° F. storage to a dark brown in those from 32°. This increase in brown color to a dark brown in the products from storage at 40°, 36°, and 32° was probably due to the caramelization of sugar. Parallel with the darkening in color in the French fries was a general increase in undesirable sweetness, although this was not apparent in the chips.

The French fried potatoes from 50° and 60° F. storage were rather mealy in texture with a pleasant flavor that was considered a standard for potatoes cooked in this way. From the 40° storage the product was unattractive, being somewhat oily, medium brown in color, and barely edible, since they were somewhat burned and also slightly sweet. From the 36° and 32° storage material, the French fries were decidedly undesirable, being sweet, flabby, oily, tough, and with a burned flavor and very dark-brown color, due to the caramelization of the sugar.

Potato chips made from tubers from the 60° F. storage were the most desirable, since they were of a uniform light golden-yellow color, crisp, and of an excellent flavor. The chips made from potatoes stored at 50° were slightly darker and somewhat mottled in color, but in other respects they were equal to the chips made from the potatoes stored at 60°. From potatoes stored at 40° the chips when cooked to the best condition possible were oily, slightly charred on the edges, and brown in general color. The best of these chips were edible, but would have been unsalable as a commercial product. Chips made from potatoes stored at 36° or 32° were not edible because of their burned flavor and oiliness.

CHEMICAL STUDIES

In addition to the cooking tests described, carbohydrate analyses were made on similar samples from all varieties from all of the storage temperatures used. Samples for this purpose were taken at the same time the cooking tests were made (Mar. 28, after 124 days of storage) and also on January 4 and February 15, 1932, thus making three sampling periods after 41, 83, and 124 days of storage. These analyses

TABLE 4.—*Condition of French fries and chips made from Irish Cobbler, Green Mountain, Russet Burbank, and Katahdin potatoes after 124 days' continuous storage at given temperatures*

Variety	Storage temperature	French fries				Chips			
		Color	Texture	Flavor	General quality	Color	Texture	Flavor	General quality
	° F.								
Irish Cobbler	60	Light golden yellow.	Tender	Very desirable	Very good	Light golden yellow.	Crisp	Very desirable	Very good.
	50	Golden yellow	do	do	do	Golden yellow, slightly mottled.	do	do	Good.
	40	Medium brown	Somewhat oily	Slightly sweet and slightly burned.	Not especially attractive, edible.	Brown, mottled	Oily	Fair	Charred on edges, not usable.
	36	Dark brown	Flabby, tough, somewhat oily.	Disagreeable, burned, sweet.	Undesirable, not edible.	Very brown	Oily, flabby	Poor, burned	Centers raw, charred on edges, not usable.
	32	do	Soggy, oily	do	do	do	do	Very poor, burned, very sweet.	Do.
Green Mountain	60	Light golden yellow.	Tender	Very desirable	Very good	Light golden yellow.	Crisp	Very desirable	Very good.
	50	Golden yellow	do	do	do	Slightly mottled, yellow and brown.	do	do	Good.
	40	Medium brown	Somewhat oily	Slightly sweet and slightly burned.	Not especially attractive, edible.	Brown	do	Slightly burned	Charred on edges, not usable.
	36	Dark brown	Flabby, tough, somewhat oily.	Disagreeble, burned, sweet.	Undesirable, not edible.	Very brown	Oily, flabby	Poor, burned	Centers raw.
	32	do	Soggy, oily	do	do	do	do	Very poor, burned.	Do.
Russet Burbank	60	Light golden yellow, slightly mottled.	Dry, tender	Very desirable	Very good	Light golden yellow.	Crisp	Very desirable	Very good.
	50	Golden yellow	do	do	do	Slightly mottled, yellow and brown.	do	do	Good.
	40	Medium brown	Oily, flabby	Slightly sweet and slightly burned.	Not especially attractive.	Brown	do	Fair, slightly burned.	Charred on edges, not usable.
	36	Dark brown	Very oily	Disagreeble, burned, sweet.	Undesirable, not edible.	Very brown	Oily, flabby	Burned	Centers raw, edges charred, not usable.
	32	do	Soggy, oily	do	do	do	do	do	Do.

Katahdin	60	Light golden yellow.	Tender	Very desirable	Very good	Light yellow, slightly mottled.	Crisp	Very desirable	Very good.
	50	Golden yellow	do	do	do	Somewhat mottled.	do	Desirable	Good.
	40	Medium brown	Somewhat oily	Slightly burned and slightly sweet.	Not especially attractive, edible.	Brown	do	Slightly burned	Charred on edges, not usable.
	36	Dark brown	Flabby, tough, somewhat oily.	Disagreeable, burned, sweet.	Undesirable, not edible.	Very brown	Oily, flabby	Burned	Do.
	32	do	Soggy, oily	do	do	do	do	do	Do.

were made on uncooked material only. The sampling procedure was as follows:

From each lot 20 representative specimens were selected and quartered longitudinally without removing the skin. One quarter from each tuber was then taken to make a composite sample which was ground fine in a hand mill. After this sample was thoroughly stirred, duplicate 50-g samples were quickly weighed out and immediately covered with 95-percent alcohol and boiled for 1 minute. After cooling, each sample was transferred to a 500-ml flask and made up to approximately 400 ml with 95-percent alcohol. The analyses were made several months after the last samples were taken.

METHOD OF ANALYSIS

The clear alcoholic extract was siphoned off and set aside, while the residue from each sample was transferred to a weighed 33 by 94 mm extraction thimble and extracted in a Soxhlet extractor with fresh 95-percent alcohol for about 4 hours. After cooling, this extract was added to that previously set aside and the whole made up to 500 ml. A 50-ml aliquot of the extract was then evaporated until all alcohol was expelled and then transferred to a 250-ml flask. After sufficient basic lead acetate was added to clear the solution it was brought up to volume, filtered, and deleaded with sodium oxalate. After filtering again a 50-ml aliquot of this solution was used for determining reducing sugar according to the Bertrand modification of the Munson and Walker method. To determine total sugar another 50-ml aliquot was hydrolyzed overnight with 5 ml of concentrated hydrochloric acid and then brought to 100-ml volume and neutralized with sodium carbonate. A 50-ml aliquot of this was then run as for reducing sugar. Sucrose was determined by difference. All sugars are expressed as dextrose.

After the extraction of the sugar was complete the thimble with the residue was placed overnight in a hot-air drying oven held at 65° C. (149° F.) and then transferred to a vacuum oven held at the same temperature until a constant weight was obtained. After weighing, the residue was removed and ground in a mortar and sifted until it was reduced to a fine powder. A 1-g sample of this was put into a 500-ml Erlenmeyer flask and refluxed with 10 ml of concentrated hydrochloric acid and 200 ml of water for 2½ hours. The sample was then nearly neutralized with a concentrated sodium hydroxide solution, cleared with basic lead acetate, brought up to volume, and deleaded with sodium oxalate. A 25-ml aliquot was then diluted up to 50 ml and used as for reducing sugar. The result, which represents the total amount of acid-hydrolyzable polysaccharides expressed as dextrose, is used here as an expression of the starch content.

Alcohol-soluble solids were determined by evaporating a 100-ml aliquot of the extract, from which sugar was determined, in a vacuum oven, and weighing until constant. Insoluble solids were determined by weighing the dried residue in the extraction thimbles after extraction was completed as described.

The results of the analyses of all the varieties at the beginning of the storage period, which, as before stated, was 11 days after the potatoes were dug, are given in table 5, while the results of analyses after 41, 83, and 124 days' storage are shown in table 6. These results for the Green Mountain variety after 124 days' storage are

further illustrated by figure 1. Without entering into a detailed digest of all the results given, it is desired to direct particular attention to the general increase in the sugar content of all the varieties of potatoes as the storage temperature decreased from 50° to 32° F. Simultaneously with the increase in sugar there was a corresponding decrease in starch content. Probably the most significant fact brought out by these analyses from the point of view of this investigation was the close similarity of the sugar, starch, and soluble and insoluble solids content of the potatoes after storage at temperatures of 60° and 50° F. with the content of these constituents in the same lots of potatoes when first put into storage 11 days after digging.

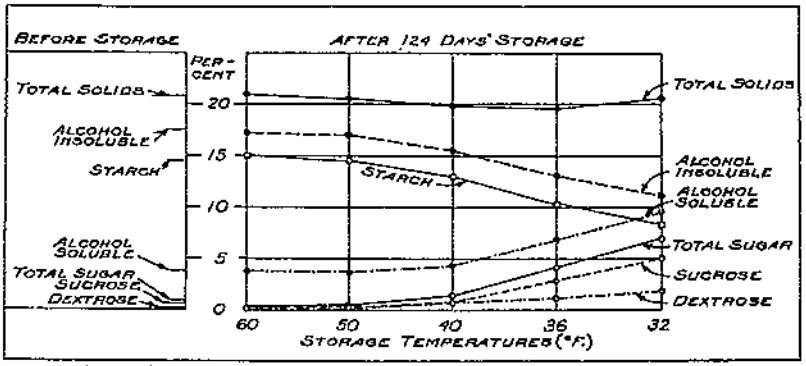

FIGURE 1.—Carbohydrate content of Green Mountain potatoes before storage and after 124 days' storage at 60°, 50°, 40°, 36°, and 32° F.

TABLE 5.—*Sugar, starch, and solids content of Irish Cobbler, Green Mountain, Katahdin, and Russet Burbank potatoes before going into storage (11 days after digging)*

[Sugars expressed as dextrose]

Variety	Sugar			Starch [1]	Solids		
	Reducing	Sucrose	Total		Alcohol soluble	Alcohol insoluble	Total
	Percent	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
Irish Cobbler	0.17	0.60	0.77	15.20	3.15	17.50	20.65
Green Mountain	.14	.60	.74	14.50	3.70	17.15	20.85
Katahdin	.35	.51	.86	14.70	3.20	16.85	20.05
Russet Burbank	.20	.42	.08	11.40	3.15	17.08	20.23

[1] Acid-hydrolyzable polysaccharides expressed as dextrose.

TABLE 6.—*Sugar, starch, and solids content of Irish Cobbler, Green Mountain, Russet Burbank, and Katahdin potatoes after approximately 6-week successive periods during storage at given temperatures*

[Sugars expressed as dextrose]

Variety	Storage temperature	After 41 days							After 83 days							After 124 days						
		Sugar			Starch[1]	Solids			Sugar			Starch[1]	Solids			Sugar			Starch[1]	Solids		
		Reducing	Sucrose	Total		Alcohol soluble	Alcohol insoluble	Total	Reducing	Sucrose	Total		Alcohol soluble	Alcohol insoluble	Total	Reducing	Sucrose	Total		Alcohol soluble	Alcohol insoluble	Total
	°F.	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent
Irish Cobbler	60	0.47	0.56	1.03	-------	3.10	17.58	20.68	0.41	0.43	0.84	-------	2.50	16.91	19.41	0.13	0.24	0.37	-------	-------	18.13	------
	50	.57	.49	1.06	-------	2.95	17.24	20.19	.42	.51	.93	-------	2.75	17.70	20.45	.17	.34	.51	-------	-------	17.63	------
	40	1.13	1.10	2.23	-------	4.55	15.93	20.48	1.07	.67	1.74	-------	3.80	16.77	20.57	.64	.81	1.45	-------	-------	16.32	------
	36	2.11	2.19	4.30	-------	6.25	13.86	20.11	1.88	1.83	3.71	-------	6.45	14.33	20.78	1.79	1.54	3.33	-------	-------	13.84	------
	32	2.02	3.40	5.42	-------	8.00	12.98	20.98	3.21	2.15	5.36	-------	8.50	13.33	21.83	2.64	1.95	4.59	-------	-------	13.13	------
Green Mountain	60	.33	.47	.80	14.30	2.95	16.10	19.05	.04	.44	.48	14.50	3.50	16.87	20.37	.03	.09	.12	15.00	3.75	17.23	20.98
	50	.33	.52	.85	14.90	3.50	17.17	20.67	.26	.44	.70	14.70	3.45	16.98	20.43	.04	.46	.50	14.70	3.60	17.01	20.61
	40	.92	1.31	2.23	12.70	4.45	15.72	20.17	.91	.62	1.53	14.00	4.50	16.50	21.00	.73	.74	1.47	13.00	4.25	15.55	19.80
	36	1.65	3.81	5.46	10.20	6.55	12.88	19.43	1.20	3.36	4.56	10.80	7.20	13.02	20.22	1.14	3.00	4.14	10.30	6.70	12.88	19.58
	32	1.90	5.40	7.30	8.80	8.15	11.65	19.80	2.24	5.51	7.75	9.40	6.15	11.89	18.04	1.88	5.06	6.94	8.30	9.60	11.04	20.64
Russet Burbank	60	.31	.33	.64	-------	2.40	16.90	19.30	.15	.44	.59	15.50	2.70	17.50	20.20	.05	.21	.26	15.90	2.50	16.88	19.38
	50	.33	.35	.68	-------	2.80	16.97	19.77	.35	.39	.74	15.10	2.85	17.32	20.17	.16	.32	.48	15.80	2.40	17.79	20.19
	40	.99	.50	1.49	-------	3.65	16.07	19.72	.64	.47	1.11	14.50	3.75	16.88	20.63	.56	.57	1.13	14.30	2.70	16.70	19.40
	36	1.92	1.75	3.67	-------	5.95	14.12	20.07	1.81	1.21	3.02	11.70	5.25	14.25	19.50	1.38	1.14	2.52	11.90	5.10	14.86	19.96
	32	2.74	2.81	5.55	-------	7.70	11.94	19.64	2.30	2.77	5.07	-------	6.85	13.00	19.85	2.19	2.29	4.48	10.30	5.90	13.02	18.92
Katahdin	60	.15	.52	.67	15.30	3.10	17.13	20.23	.21	.43	.64	14.70	2.95	16.14	19.09	.11	.44	.55	14.80	3.00	16.88	19.88
	50	.26	.41	.67	15.00	2.95	17.28	20.23	.37	.42	.79	15.30	2.95	17.22	20.17	.27	.33	.60	14.80	3.25	16.63	19.88
	40	.99	.78	1.77	13.50	4.40	15.51	19.91	1.12	.68	1.80	13.50	4.25	15.47	19.72	1.08	1.13	2.21	13.10	3.70	15.35	19.05
	36	1.71	2.05	3.76	11.30	6.50	13.07	19.57	2.01	2.51	4.52	10.80	6.75	12.89	19.64	1.74	2.77	4.51	11.40	7.50	12.97	20.47
	32	2.11	3.29	5.40	9.40	7.70	11.52	19.22	2.57	3.50	6.07	9.20	8.45	11.40	19.85	2.36	4.83	7.19	8.50	9.75	11.37	21.12

[1] Acid-hydrolyzable polysaccharides expressed as dextrose.

In addition to those reported here, further physiological studies in connection with the various changes due to different storage temperatures would be highly desirable. There has been noted at temperatures below 50° F. an increase in sugars and a parallel decrease in starch, particularly at 32° and 36°. This was accompanied by a diminution in mealiness and an increase in sogginess. An explanation offered for this particular fact is that correlated with the hydrolysis of starch there is a release of imbibed or bound water into a free state. There is also noted an increased brittleness in texture of the uncooked tissue and a slight increase in the yellowish tint in both the uncooked and cooked tissues. These would indicate other than carbohydrate changes. Definite conclusions on these matters cannot be drawn without additional investigation.

Comparing the analyses for the successive sampling periods both with the Irish Cobbler and Green Mountain varieties from 60° and 50° F. storage, there is noted a slight increase in total sugar during the first period of 41 days followed by a decrease after 124 days to a point slightly below the original content at the beginning of storage. With the other two varieties there appeared to be a very slight general decrease in total sugar at these temperatures. In the 40° storage with all varieties there was a distinct increase in total sugar during the first storage period of 41 days, followed by a slight decrease in three of the varieties, but with the Katahdin there was a slight increase after the first sampling period. In all varieties from storage at 36° and 32° F. there was a rather sharp increase in total sugar shown at the first sampling period after storage. With the Irish Cobbler and Russet Burbank variety this was followed by a slight decrease in total sugar, whereas with the Green Mountain there was a slight increase between the 41 and 83 days' storage, followed by a decrease; with the Katahdin there was a general increase after 41 days, but the rate was not so fast as during the first 41 days.

After 41 days of continuous storage, sample lots from each variety in storage at 32°, 36°, and 40° F. were transferred to 70° to remain for 6 weeks; at the same time lots from 60° and 50° storage were moved to 40° for the same period. At the expiration of this time all of these were then sampled at the same time with the lots that had been in continuous storage for 83 days. These transfers were made to approximate conditions that obtain when potatoes have been left either at a comparatively high temperature until sprouting has started or is about to start and the potatoes must be moved to a lower temperature to keep them dormant, or at a comparatively low temperature until perhaps their sugar content is too high for satisfactory table purposes and it is desired to move them to a higher temperature so that this sugar will be lessened. In either case it was desired to study the carbohydrate changes taking place after such transfers.

In table 7 are shown the results of determinations on potatoes after being moved from 40°, 36°, and 32° F. storage for 6 weeks to 70° for 6 weeks, as compared with check lots that have remained continuously at the original temperatures. Unfortunately for the purpose of comparison, data are not available to show the carbohydrate composition of similar lots of potatoes stored continuously at 70°. However, data for potatoes in continuous storage at 60° were procured, and using these for comparison it is seen that with all varieties moved from storage at 40°, the sugar content after 6 weeks

decreased to approximately that of similar potatoes held at 60°, at which temperature the cooking quality in all varieties was at its optimum. However, with the other lots moved from 36° and 32° to 70° the sugar content did not decrease to that of lots moved from 40° to 70°, even after they were held for 6 weeks at 70°. At this time the sugar content of those from 32° was still higher than of those from 36°. In general these results would seem to indicate that where the sugar content of potatoes is relatively high, as will occur when they are stored for some time at 32° to 36°, a recovery period of 6 weeks at 70° is not sufficient to bring down the sugar content to a point where the quality is as satisfactory as that of tubers kept constantly at 60° or 70°.

TABLE 7.—*Change in the sugar, starch, and solids content of Irish Cobbler, Green Mountain, Russet Burbank, and Katahdin potatoes after storage for approximately 6 weeks at 40°, 36°, and 32° F., and for approximately 6 subsequent weeks at 70° F., as compared with those stored continuously at 40°, 36°, and 32° F.*

[Sugars expressed as dextrose]

Variety	Storage treatment, continuous and transferred	Sugar			Starch[1]	Solids		
		Reducing	Sucrose	Total		Alcohol soluble	Alcohol insoluble	Total
		Percent	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
Irish Cobbler	40° continuously	1.07	0.67	1.74	------	3.80	16.77	20.57
	40° to 70°	.48	.47	.95	15.0	3.05	16.51	20.18
	36° continuously	1.88	1.83	3.71	------	6.45	14.33	20.78
	36° to 70°	.93	.62	1.45	13.3	4.20	14.83	19.03
	32° continuously	3.21	2.15	6.36	------	8.50	13.33	21.83
	32° to 70°	1.36	.57	1.93	13.1	4.75	14.50	19.25
Green Mountain	40° continuously	.91	.62	1.53	14.00	4.50	16.50	21.00
	40° to 70°	.07	.50	.57	14.40	3.75	16.37	20.12
	36° continuously	1.20	3.30	4.56	10.80	7.20	13.02	20.22
	36° to 70°	.42	1.20	1.62	12.60	4.75	14.78	19.53
	32° continuously	2.24	5.51	7.75	9.40	6.15	11.89	18.04
	32° to 70°	.56	1.69	2.25	13.30	5.45	15.31	20.76
Russet Burbank	40° continuously	.64	.47	1.11	14.50	3.75	16.88	20.63
	40° to 70°	.20	.28	.48	15.70	3.30	16.93	20.23
	36° continuously	1.81	1.21	3.01	11.70	5.25	14.25	19.50
	36° to 70°	.37	.28	.65	14.30	3.45	15.65	19.10
	32° continuously	2.30	2.77	5.07	------	6.85	13.00	19.85
	32° to 70°	.59	.50	1.02	14.1	3.55	16.12	19.67
Katahdin	40° continuously	1.12	.68	1.80	13.50	4.25	15.47	19.72
	40° to 70°	.21	.47	.68	15.40	3.60	17.17	20.77
	36° continuously	2.01	2.51	4.52	10.80	6.75	12.89	19.64
	36° to 70°	.89	.65	1.54	13.50	4.25	16.68	19.93
	32° continuously	2.57	3.50	6.07	9.20	8.45	11.40	19.85
	32° to 70°	1.33	2.08	3.41	12.20	6.35	14.41	20.96

[1] Acid-hydrolyzable polysaccharides expressed as dextrose.

The results of analyses of potatoes moved after 6-weeks' storage at 60° and 50° to 40° F. for 6 weeks, as compared with similar lots held continuously at 60°, 50°, and 40° are given in table 8. A surprising result of these analyses is the indication of an apparent stimulation in the building up of sugar in the lots of potatoes moved to 40° storage. This is seen in comparing these results with those obtained in tests with potatoes held continuously at 40°. In those moved from 60° to 40° storage this is most marked, as in every instance the sucrose and total sugar content is higher than in the lots stored continuously at 40°. When lots were moved from 50° to 40° the total and reducing sugar contents were always lower than in the lots held continuously at 40°, but in all but one instance the sucrose content was somewhat higher.

TABLE 8.—*Change in the sugar, starch, and solids content of Irish Cobbler, Green Mountain, Russet Burbank, and Katahdin potatoes after storage for approximately 6 weeks at 60° and 50° F., and for approximately 6 subsequent weeks at 40°*

[Sugars expressed as dextrose]

Variety	Storage treatment continuous and transferred	Sugar			Starch[1]	Solids		
		Reducing	Sucrose	Total		Alcohol soluble	Alcohol insoluble	Total
		Percent	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
Irish Cobbler	60° continuously	0.41	0.43	0.84	-------	2.60	16.91	19.41
	60° to 40°	.56	1.59	2.15	13.5	5.30	14.90	20.20
	40° continuously	1.07	.67	1.74	-------	3.80	16.77	20.57
	50° continuously	.42	.51	.93	-------	2.75	17.70	20.45
	50° to 40°	.41	.84	1.25	13.20	3.70	14.46	18.16
	40° continuously	1.07	.67	1.74	-------	3.80	16.77	20.57
Green Mountain	60° continuously	.04	.44	.48	14.50	3.50	16.87	20.37
	60° to 40°	.57	1.67	2.24	12.70	4.80	14.47	19.27
	40° continuously	.91	.62	1.53	14.00	4.50	16.50	21.00
	50° continuously	.26	.44	.70	14.70	3.45	16.98	20.43
	50° to 40°	.21	.95	1.16	14.20	4.25	15.83	20.08
	40° continuously	.91	.62	1.53	14.00	4.50	16.50	21.00
Russet Burbank	60° continuously	.15	.44	.59	15.50	2.70	17.50	20.20
	60° to 40°	.82	.60	1.42	14.80	3.75	16.21	19.96
	40° continuously	.64	.47	1.11	14.50	3.75	16.88	20.63
	50° continuously	.35	.39	.74	15.10	2.85	17.32	20.17
	50° to 40°	.42	.34	.76	15.00	3.30	16.73	20.03
	40° continuously	.64	.47	1.11	14.50	3.75	16.88	20.63
Katahdin	60° continuously	.21	.43	.64	14.70	2.95	16.14	19.09
	60° to 40°	1.02	.89	1.91	12.40	4.45	13.90	18.35
	40° continuously	1.12	.68	1.80	13.50	4.25	15.47	19.72
	50° continuously	.37	.42	.79	15.30	2.95	17.22	20.17
	50° to 40°	.72	.77	1.49	14.70	4.05	16.33	20.38
	40° continuously	1.12	.68	1.80	13.50	4.25	15.47	19.72

[1] Acid-hydrolyzable polysaccharides expressed as dextrose.

At the same time that samples for the carbohydrate determinations were being prepared portions of the same material were given the picric acid colorimetric test described by Peacock and Brunstetter (*4*) as a simple method for predetermining the culinary quality of potatoes as affected by the accumulation of soluble sugars. The method of procedure was as follows: From a sample lot of 20 specimens a cylinder of tissue from the central part of each tuber with an inside diameter of three-sixteenths of an inch was cut with a cork borer. From each of these cylindrical pieces a 1-inch length, measuring from the skin, was cut. Each group of 20 pieces was then submerged in 40 ml of a solution made up by mixing for each test 20 ml of a saturated picric acid solution and 20 ml of a 20-percent sodium carbonate solution. This was then heated over a bunsen flame for 1 minute, which brought the liquid almost to a boil and also developed the characteristic color as influenced by the amount of sugar present. After cooling, a drop of the colored liquid was absorbed on white filter paper and the color compared and matched with color charts illustrated by Maerz and Paul (*2*).

The original coloration obtained for the different varieties before going into storage, as determined by the picric-acid coloration test, were Irish Cobbler 9–L–1,[2] Green Mountain 9–L–2, Katahdin 9–L–3, and Russet Burbank 9–L–2. After 41, 83, and 124 days' storage the colors as recorded are shown in table 9. These colors may be described as varying from shades of pale lemon to pale orange-yellow

[2] This designation refers to color charts in Maerz and Paul (*2*). The first number indicates the plate number and the letter and the succeeding number indicate the location of the color on the plate.

for potatoes before going into storage, which gradually intensify to shades of dirty brownish orange as the storage temperature decreases from 60° to 32° F.

TABLE 9.—*Coloration, as denoted by the picric-acid coloration test, of Irish Cobbler, Green Mountain, Katahdin, and Russet Burbank potatoes after storage for given periods and temperatures*

Variety	Coloration [1] after sampling period and storage temperatures (°F.) of potatoes stored—					
	Before storage	41 days				
		60°	50°	40°	30°	32°
Irish Cobbler	9-L-1	9-L-7	10-L-1	11-L-3	11-L-5	12-L-6
Green Mountain	9-L-2	9-L-8	10-L-1	11-L-3	11-L-5	12-L-6
Katahdin	9-L-3	9-L-9	10-L-2	11-L-4	11-L-7	12-L-8
Russet Burbank	9-L-2	9-L-8	9-L-9	10-L-2	11-L-6	12-L-7

Variety	Coloration [1] after sampling period and storage temperatures (°F.) of potatoes stored—									
	83 days					124 days				
	60°	50°	40°	36°	32°	60°	50°	40°	36°	32°
Irish Cobbler	10-L-2	10-L-4	11-L-6	11-L-7	12-L-8	9-J-2	9-J-3	10-J-5	11-K-8	11-H-9
Green Mountain	10-K-2	10-L-3	11-L-6	11-L-7	12-L-8	9-K-2	9-I-3	10-I-6	10-K-7	11-F-9
Katahdin	10-L-3	10-L-8	11-L-7	11-L-7	12-L-9	9-G-5	9-J-4	10-G-7	11-G-8	11-H-9
Russet Burbank	10-L-2	10-L-3	10-L-5	12-L-8	12-L-9	9-K-2	9-H-4	10-J-5	11-I-8	11-H-9

[1] See footnote 1, table 3.

SUMMARY

Increased interest in factors affecting the cooking qualities of potatoes has been stimulated by the demand of restaurateurs and potato-chip manufacturers for dependable stocks of potatoes that will more suitably and uniformly fulfill their needs.

As reported in this investigation, several varieties of potatoes were stored within a short time after harvest at controlled temperatures ranging from 32° to 70° F. Cooking tests and carbohydrate analyses were made after storage at definite temperatures.

Cooking tests consisted in steaming, boiling, baking, French frying, and chip making. When cooked by the first three methods the potatoes from storage at 70°, 60°, or 50° F. for several weeks were of a light-cream color, mealy in texture, and of a desirable flavor. In contrast to these, similar lots of potatoes from storage at 40°, 36°, or 32° showed in the cooked products a change in color marked by an increase in yellow intensity. Parallel with this the texture became more soggy or watery, and the flavor was marked by an increase in unpleasant sweetness. The flavor of the steamed, boiled, or baked potatoes from this low-temperature group, however, was fair if not tasted immediately after those from the higher storage temperatures; but when the two were contrasted a distinct sweetness was noticeable in the low-temperature group.

When French fries were made from potatoes stored at 70°, 60°, or 50° F. the quality was desirable in every way and the color was light yellow or creamy. With tubers from the 40° storage the flavor was

slightly sweet and in most instances slightly burned, and the color tended to be darker than was desirable. In general, French fries made from potatoes of all varieties from storage at 40°, 36°, or 32° were not edible.

The consumers of commercial potato chips are discriminating, in that they demand a light-colored product. With the material used in this investigation this kind of product was only possible with potatoes stored at 70° or 60° F. From potatoes stored at 50°, chips were desirable in all respects except color. In this respect they tended to be brown or in some cases mottled with brownish areas, which would necessitate the discarding of much of this material in order to make a desirable commercial product. From storage temperatures of 40° or below, all of the varieties of potatoes made chips that were generally not usable. As the storage temperature decreased there was an increase in intensity of the brown color until in those from the 32° storage an almost black appearance was observed. In the potatoes from this lower range of storage temperatures the accumulated sugar quickly caramelized when the potatoes were put into the cooking oil and rendered them unfit for use, as shown by the brown to black color and burned taste which developed.

In the four varieties of potatoes used, carbohydrate analyses were made at three successive periods during their storage. One of these periods coincided with a cooking test, and in all varieties a definite increase in sugar content was shown as the storage temperature was diminished. In contrast to the increase in sugar there was a general lowering of quality, as denoted by flavor and texture. The dividing line between relatively high and low sugar content, as well as between high and low quality in cooked products, occurred between 50° and 40° F. Comparing the analyses at the three different sampling periods, namely, after 41, 83, and 124 days of storage, there were, after the first period, minor fluctuations in parallel carbohydrate content, but their relation to storage temperatures remained essentially the same. The analyses of potatoes from 60° and 50° storage showed their sugar and starch contents to be practically the same as when the potatoes were put into storage, which fact coincides with the better table quality of the potatoes from these storage temperatures. At the lower temperatures the sugar content progressively increased, and the starch decreased as the temperature diminished.

When after 6 weeks' storage at 40°, 36°, and 32° F. potatoes were moved to 70° for 6 weeks, the sugar content of those from 40° storage was found to be close to that of similar lots when first put into storage; however, in the lots from 36° and 32° the sugar content was still relatively high.

When after 6 weeks' storage at 60° and 50° F., potatoes were moved to 40° F. for 6 weeks, those from 60° storage generally increased in reducing sugar and sucrose over those remaining continuously in storage at 40°, but in most instances of those moved from 50° the sucrose content was greater than in those held continuously at 40°, while reducing sugar was generally less in amount.

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