Chemical Composition and Freezing Adaptability of Peach Varieties Grown in Western New York

By Frank A. Lee, George Oberle, and Joanne Whitcombe

NEW YORK STATE
AGRICULTURAL EXPERIMENT STATION
CORNELL UNIVERSITY
GENEVA, N. Y.

Bulletin No. 768 April, 1954

Abstract

FIFTY-NINE varieties and seedlings of yellow peaches and 22 varieties of white peaches grown under western New York conditions were examined chemically to determine whether any relationship exists between certain chemical factors and their adaptability for freezing preservation.

No relation was found between the freezing adaptability of any of the varieties or seedlings and their ascorbic acid and carotene content, soluble solids, free acids, and pH. Some other chemical factor may well affect varietal differences for freezing adaptability.

The best sorts of yellow peaches from the standpoint of good freezing quality were J. H. Hale and Midway for commercially grown varieties and McAllister (which received the highest rating of all), Morse No. 1, Ideal, N. J. 128, Eclipse, and Viceroy, among the less well-known kinds. All of these were better than Elberta, although the latter gave a fairly good product.

The outstanding white varieties were Champion and Polly.

A publication of the
New York State Agricultural Experiment Station
Geneva, N. Y.
New York State College of Agriculture
A unit of the State University of New York
At Cornell University

Bulletin No. 768

Chemical Composition and Freezing Adaptability of Peach Varieties Grown in Western New York

By Frank A. Lee, George Oberle,[1] and Joanne Whitcombe

Introduction

IT has been found advantageous to preserve a substantial part of the peach crop by freezing, because of the excellence of the finished product. The total United States pack of frozen peaches in 1952 amounted to 35,500,000 pounds, 3,400,000 pounds of which were packed in the eastern part of the country (16).[2]

The present study was undertaken to determine differences in freezing adaptability and the relationship to ascorbic acid and carotene content, soluble solids, free acids, and pH of varieties grown in New York State.

Review of Literature

While information is available in the literature on chemical changes taking place during the development and ripening of the peach, data are lacking on the relationship between chemical composition and quality of the frozen product.

Lee and Tukey (6) studied the changes in chemical composition of the developing Elberta peach. Chemical and physical changes in the ripening Elberta peach were investigated by Culpepper and Caldwell (4). Nelson (8) found by means of the ester distillation method that the non-volatile acids of the peach were mainly L-malic acid and citric acid, in almost equal proportions.

Blake (1) and Blake and Davidson (2) divided peaches into four classes, based on the number of milliliters of 0.1N sodium hydroxide solution required to titrate a 10-milliliter sample of freshly extracted peach juice. Their grouping was as follows: Class 1, very low in acid, 7 and less; class 2, low in acid, 7 to 10; class 3, medium acid, 10 to 13; and class 4, high, 13 and above. Blake found that some varieties were rather consistent, and showed small variations from season to season. Other peach varieties were inconsistent.

[1]Now Professor of Horticulture, Virginia Agricultural Experiment Station, Blacksburg, Va.

[2]Figures in parenthesis refer to Literature Cited, page 12.

Chatfield and Adams (3) gave complete proximate analyis of peaches, including total acid calculated as malic. The carotenoid pigments of the peach were studied by Mackinney (7) and Thaler and Schulte (13). Schroder, *et al.* (12) reported that the average difference in ascorbic acid content of peaches within varieties was 4.29 mg per cent, while extreme differences among varieties were 9.02 mg per cent. Tressler and DuBois (15) first proposed the use of ascorbic acid for processing peaches for freezing.

Ross, Bartlett, and Hard (11) studied the effectiveness of antioxidants on peaches and other fruits by the use of oxidation-reduction potentials. They found that the use of citric acid in combinations with ascorbic acid and the use of commercial mixes of these acids are not so effective in maintaining a reducing environment as is ascorbic acid alone.

Cultural Conditions

During 1945, 1946, and 1947, 59 yellow varieties and 22 white varieties of peaches were grown in the Station variety test plot. This plot is a silty clay loam soil. The fruit was harvested when it was table ripe. Some varieties, normally ripening late in the season, were harvested a few days before this condition was reached because of danger of frost. Such samples were allowed to remain at room temperature from one to several days to ripen before analyses were started and before being packed for taste tests.

Temperature and rainfall data are given in Table 1.

Sampling and Analytical Methods

Opposite eighths of 12 to 15 peaches were sliced into known weights of 5 per cent metaphosphoric acid solution for the determination of

TABLE 1.—TOTAL RAINFALL AND AVERAGE TEMPERATURE.

JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER
		1945		
3.42 in. 65.42°F	2.38 in. 71.61°F	1.51 in. 70.47°F	7.71 in. 66.15°F	4.28 in. 51.16°F
		1946		
4.10 in. 65.7°F	2.59 in. 70.98°F	3.61 in. 66.10°F	3.80 in. 64.73°F	3.59 in. 56.47°F
		1947		
2.84 in. 66.52°F	4.27 in. 71.18°F	5.85 in. 75.21°F	2.40 in. 64.58°F	0.81 in. 59.65°F

ascorbic acid. The mixture was weighed, and the weight of peach flesh used in the sample was thus determined. In each case, the sample exceeded 100 grams in weight. The analyses were made by the indophenol-xylene extraction method (10).

Samples for the carotene determinations were prepared by grinding the frozen flesh (at 0° F) in the zero room with a food chopper. Twenty-five-gram samples of the ground material were analyzed according to the foaming mixture and chromatographic method described in the Methods of Vitamin Assay (14).

Total solids were determined by partially drying 20-gram samples of the ground frozen material on the steam bath, followed by complete drying in the vacuum oven at 70° C for 48 hours.

Brix readings were made on the extracted juice with a Zeiss hand refractometer. The degree Brix represents an approximation of the percentage of total soluble solids.

The pH of the extracted juice was determined with a Beckman Model G pH meter.

Free acids were measured by diluting a 10-ml sample and titrating with 0.1N sodium hydroxide to 8.2 on the pH meter. According to Nelson (8), the acid of peaches is largely a mixture of malic and citric acids in about equal proportions. The acid was calculated as malic acid.

The peaches were steam peeled, sliced, packed in 1-pint, tub-shaped containers,[3] and covered with 50 per cent sucrose sirup for freezing preservation tests. Another set was packed in the same fashion, but the samples were covered with 50 per cent sirup containing 0.2 gram of ascorbic acid to a package. A third set, was covered with 50 per cent sirup containing a one-half level teaspoonful of a mixture consisting of 4 per cent ascorbic acid and 96 per cent citric acid to a package. The filled containers were frozen in an air blast at −5° F and stored at that temperature for six months. After the storage period, the samples were thawed, coded, and tested by a panel of seven experienced judges[4] for flavor, texture, and color.

Discussion of Results

The data obtained for the three years of the study are presented in Tables 2 and 3 and in Fig. 1.

[3]Kindly furnished by the Lily-Tulip Cup Corporation, New York, N. Y.

[4]The authors wish to thank Professor J. C. Hening and members of the taste panel for their assistance.

TABLE 2.—CHEMICAL COMPOSITION OF PEACH VARIETIES GROWN AT THE EXPERIMENT STATION AT GENEVA, N. Y.

VARIETY	ASCORBIC ACID, MG PER CENT			CAROTENE, MCG PER CENT			pH			FREE ACID, PER CENT MALIC ACID			SOLUBLE SOLIDS, °BRIX			TOTAL SOLIDS, PER CENT		
	1945	1946	1947	1945	1946	1947	1945	1946	1947	1945	1946	1947	1945	1946	1947	1945	1946	1947
Yellow Varieties and Seedlings																		
Armstrong	—	—	—	1280	—	—	3.86	—	—	0.54	—	—	12.4	—	—	—	—	—
Arp	—	—	9.3	—	—	630	3.68	—	3.66	0.73	—	0.59	9.2	—	8.5	—	—	9.4
Colora	—	10.9	—	—	—	—	—	3.67	—	—	0.41	—	—	9.6	—	—	—	—
Dewson*	—	—	6.5	—	—	480	4.02	—	3.69	0.42	—	0.50	13.7	—	7.5	—	—	10.6
Early Crawford	—	—	7.0	—	—	670	3.94	—	3.80	0.73	—	0.61	14.4	—	10.9	—	—	11.8
Eclipse	12.1	16.5	8.1	800	800	730	4.07	3.35	3.61	0.47	0.74	0.34	12.9	11.0	8.2	—	—	9.8
Elberta	10.8	16.0	6.4	—	—	430	3.79	3.61	3.69	0.52	0.59	0.54	10.8	11.2	11.0	—	—	11.8
Fair Beauty	—	—	6.5	—	—	430	—	—	3.70	—	—	0.49	—	—	9.3	—	—	11.1
Fertile Hale	—	9.5	—	—	—	—	—	3.60	—	—	0.60	—	—	11.4	—	—	—	—
Fisher	5.7	5.9	8.2	920	1040	1030	3.64	3.72	3.65	0.60	0.53	0.54	11.7	9.8	9.9	—	—	10.3
Golden Beauty	—	—	6.2	—	—	470	3.84	—	3.51	0.67	—	0.77	11.5	—	10.7	—	—	12.0
Goldeneast	—	—	9.9	—	—	330	—	—	3.75	—	—	0.64	—	—	10.3	—	—	12.0
Golden Globe	12.7	8.4	6.2	—	—	580	3.98	—	3.79	0.57	0.52	0.56	14.6	11.3	10.3	—	—	10.6
Golden Jubilee	9.0	7.4	6.1	960	820	550	3.88	3.61	3.68	0.56	0.63	0.48	11.8	9.5	7.3	—	—	8.3
Goldfinch	11.2	8.6	7.3	—	—	320	4.08	3.60	3.88	0.48	0.53	0.36	13.0	10.2	7.3	—	—	9.4
Halehaven	16.5	10.9	5.0	—	—	540	3.96	3.60	3.75	0.52	0.54	0.43	13.8	9.7	7.3	—	—	8.7
Hardee	9.5	6.4	5.9	—	—	600	3.81	3.58	3.90	0.66	0.51	0.36	12.4	10.8	8.2	—	—	10.8
Ideal	9.9	9.5	—	—	—	—	3.94	3.51	—	0.48	0.60	—	11.2	10.8	—	—	—	—
J. H. Hale	13.8	8.2	4.8	—	—	480	3.70	3.59	3.72	0.73	0.64	0.59	12.0	12.6	13.0	—	—	12.0
July Elberta	16.9	12.5	7.1	—	—	670	3.98	—	3.83	0.55	0.61	0.51	15.2	11.0	8.3	—	—	11.2
Kalhaven	—	—	7.0	—	—	520	—	—	4.05	—	—	0.51	—	—	9.3	—	—	11.1
Late Crawford	—	—	—	—	—	—	3.68	—	—	0.92	—	—	14.2	—	—	—	—	—
Marigold	7.0	6.1	6.5	1020	1380	370	3.72	3.68	3.79	0.62	0.56	0.56	7.0	8.9	8.0	—	—	7.4
McAllister	14.3	13.6	13.0	—	—	800	—	3.63	3.78	—	0.58	0.70	—	12.0	12.0	—	—	12.9
Michel No. 1	—	—	15.3	—	—	610	3.88	—	3.76	0.92	—	0.63	11.8	—	11.1	—	—	12.9

Midway	13.4	10.6	8.5	—	—	430	—	3.41	3.60	0.47	0.61	0.63	12.0	11.6	9.1	—	—	11.7
Mikado	—	—	9.5	—	—	570	3.76	—	3.72	0.54	—	0.52	9.2	—	9.8	—	—	12.8
Morse No. 1	9.6	16.1	7.3	—	—	720	—	3.47	4.08	—	0.62	0.44	—	9.8	7.9	—	—	9.9
Newday	11.3	6.3	7.4	—	—	750	3.71	3.50	3.65	0.65	0.58	0.64	13.8	10.1	9.5	—	—	9.7
N. J. 100	—	—	6.0	—	—	280	—	—	3.61	—	—	0.55	—	—	10.7	—	—	12.5
N. J. 105	15.1	10.4	9.3	—	—	710	3.80	3.49	3.58	0.60	0.78	0.54	14.6	10.8	9.9	—	—	12.1
N. J. 122	12.1	7.4	7.5	—	—	590	—	3.65	3.72	—	0.51	0.52	—	8.8	9.6	—	—	10.7
N. J. 128	—	—	5.8	—	980	680	—	3.65	4.12	—	0.51	0.57	—	10.4	9.6	—	—	10.6
Oriole	13.1	7.3	7.4	1060	1320	660	3.49	3.67	3.81	0.62	0.45	0.41	11.8	10.1	6.8	—	—	9.8
Pacemaker	16.2	8.4	8.6	—	—	670	—	3.49	4.00	—	0.69	0.55	—	12.4	10.2	—	—	11.3
Redelberta	—	—	6.2	—	—	790	—	—	3.69	—	—	0.68	—	—	10.0	—	—	11.3
Redhaven	7.5	8.0	6.1	1380	780	470	3.71	3.80	3.51	0.48	0.55	0.67	11.4	10.4	7.8	—	—	9.3
Reeves	17.6	23.4	—	1220	940	—	3.55	3.43	—	0.83	0.81	—	14.4	13.9	—	—	—	—
Rio Oso Gem	—	—	—	—	—	—	—	3.51	—	—	0.75	—	—	11.6	—	—	—	—
Rochester	—	—	11.2	—	—	570	3.87	—	3.71	0.64	—	0.59	15.2	—	8.3	—	—	8.7
South Haven	14.2	12.1	8.5	—	—	570	3.78	3.48	3.79	0.60	0.72	0.67	14.4	15.2	5.5	—	—	8.7
Stoke Red	—	—	7.2	—	—	580	3.68	—	3.62	0.60	—	0.47	10.1	—	9.7	—	—	10.1
Sullivan	—	—	—	—	—	—	3.72	—	—	0.74	—	—	13.6	—	—	—	—	—
Summercrest	—	—	6.7	—	—	590	—	3.62	3.74	—	0.64	0.69	—	12.3	11.1	—	—	13.2
Sunbeam	6.9	10.3	7.9	1040	950	520	3.68	3.49	3.65	0.64	0.63	0.51	9.8	12.9	7.1	—	—	8.3
Sun Glo	—	—	11.3	—	—	610	—	—	3.65	—	—	0.69	—	—	7.9	—	—	10.8
Sungold	—	—	9.8	—	—	600	3.77	—	3.80	0.60	—	0.48	13.4	—	9.6	—	—	12.5
Sunhigh	11.2	8.5	—	—	—	—	3.89	—	—	0.52	0.52	—	14.2	9.3	—	—	—	—
Triogem	9.0	6.1	7.0	1280	900	690	3.85	—	3.63	0.61	0.56	0.59	13.0	10.9	11.5	—	—	11.7
Valiant	—	—	7.3	—	—	690	3.88	—	3.59	0.49	—	0.62	12.2	—	11.0	—	—	9.7
Vanguard	—	—	7.6	—	—	740	—	—	3.68	—	—	0.58	—	—	8.4	—	—	10.1
Vedette	14.3	8.7	7.5	—	—	380	3.98	3.63	3.55	0.52	0.53	0.69	13.6	10.2	10.0	—	—	10.0
Veefreeze	—	—	5.2	—	—	680	—	—	3.68	—	—	0.69	—	—	8.8	—	—	10.7
Veteran	13.1	6.8	7.2	—	—	620	4.07	3.55	4.05	0.39	0.42	0.36	12.4	11.8	7.4	—	—	9.8
Viceroy	8.8	7.4	9.9	—	—	550	4.04	3.72	3.78	0.44	0.54	0.42	12.0	10.2	7.9	—	—	10.6
Vimy	12.3	6.9	7.0	750	800	530	3.99	—	3.65	0.49	0.65	0.65	13.8	10.4	9.1	—	—	10.9
Wilma	—	—	5.2	—	—	610	3.81	—	3.81	0.52	—	0.59	11.8	—	10.9	—	—	11.5
Yellow St. John	—	—	—	—	—	—	3.82	—	—	0.66	—	—	13.2	—	—	—	—	—
Zarn	14.9	10.8	9.4	—	—	710	3.92	3.54	3.98	0.59	0.54	0.43	13.8	10.5	7.8	—	—	10.8

*Tentative name only; not introduced and no longer available.

TABLE 2.—*Concluded.*

VARIETY	ASCORBIC ACID, MG PER CENT			CAROTENE, MCG PER CENT			pH			FREE ACID, PER CENT MALIC ACID			SOLUBLE SOLIDS, °BRIX			TOTAL SOLIDS, PER CENT		
	1945	1946	1947	1945	1946	1947	1945	1946	1947	1945	1946	1947	1945	1946	1947	1945	1946	1947
White Varieties																		
Alexander	—	—	10.4	—	—	—	—	—	3.59	—	—	0.65	—	—	9.2	—	—	10.4
Alton	—	8.8	7.6	—	—	—	—	—	3.67	—	0.45	0.50	—	8.4	8.6	—	—	9.2
Belle of Georgia	—	—	9.2	—	—	—	—	—	3.71	—	—	0.50	—	—	10.3	—	—	11.7
Carman	—	—	12.2	—	—	—	3.78	—	3.60	0.69	—	0.68	11.6	—	8.4	—	—	9.5
Champion	26.0	11.8	—	—	—	—	—	3.50	—	—	0.54	—	—	13.8	—	—	—	—
Cumberland	13.0	14.3	—	—	—	—	3.47	—	—	0.62	0.61	—	11.3	7.9	—	—	—	—
Delicious	15.5	9.3	8.6	—	—	—	3.81	—	3.52	0.51	0.53	0.44	12.4	8.9	8.1	—	—	9.8
Erly-Red-Fre	—	—	9.4	—	—	—	—	—	4.00	—	—	0.47	—	—	8.9	—	—	8.3
Florence	15.3	8.4	8.9	—	—	—	3.85	—	3.71	0.57	0.52	0.47	14.2	8.9	8.1	—	—	10.2
Gov. Hogg	—	—	9.0	—	—	—	—	—	3.59	—	—	0.53	—	—	8.8	—	—	8.3
Greensboro	—	—	7.9	—	—	—	3.54	—	3.69	0.67	—	0.47	9.8	—	8.8	—	—	9.7
Hiley	—	16.9	8.9	—	—	—	—	3.31	3.58	—	0.90	0.78	—	9.6	10.1	—	—	10.9
Kathryn	11.1	8.1	7.4	—	—	—	3.81	—	3.60	0.66	0.72	0.51	13.3	10.8	7.4	—	—	10.1
Lola Seedling	—	—	7.5	—	—	—	3.84	—	3.82	0.56	—	0.52	6.9	—	8.6	—	—	8.7
Nectar	14.4	10.2	—	—	—	—	3.79	—	—	0.63	0.48	—	13.2	9.4	—	—	—	—
Pioneer	—	—	10.6	—	—	—	—	—	3.52	—	—	0.48	—	—	9.0	—	—	8.5
Polly	22.8	15.4	10.7	—	—	—	—	3.50	3.99	—	0.64	0.39	—	13.4	9.1	—	—	11.0
Raritan Rose	—	7.7	7.4	—	—	—	—	3.50	3.60	—	0.64	0.50	—	9.5	7.8	—	—	8.7
Redrose	—	7.6	6.0	—	—	—	—	3.62	3.60	—	0.79	0.56	—	12.4	9.7	—	—	10.4
Rosebud	10.2	8.6	9.2	—	—	—	3.85	3.64	3.72	0.64	0.55	0.57	11.4	11.1	6.9	—	—	9.2
Schumaker	—	—	13.8	—	—	—	—	—	3.46	—	—	0.86	—	—	10.6	—	—	9.8
White Hale	12.7	10.5	—	—	—	—	3.76	3.61	—	0.75	0.70	—	14.4	13.6	—	—	—	—

TABLE 3.—RELATIVE ACIDITY OF PEACH VARIETIES GROWN UNDER NEW YORK CONDITIONS.*

LOW IN ACID	MEDIUM IN ACID		HIGH IN ACID	VARIABLE ACIDITY
		Yellow Varieties and Seedlings		
Colora	Armstrong	N. J. 128	Late Crawford	Eclipse
Dewson†	Arp	Pacemaker	Reeves	Golden Jubilee
Fair Beauty	Early Crawford	Redelberta		Halehaven
Goldfinch	Elberta	Redhaven		Hardee
Veteran	Fertile Hale	Rochester		Ideal
	Fisher	Rio Oso Gem		Michel No. 1
	Goldeneast	South Haven		Morse No. 1
	Golden Beauty	Sullivan		Oriole
	Golden Globe	Summercrest		Stoke Red
	J. H. Hale	Sunbeam		Sungold
	July Elberta	Sun Glo		Viceroy
	Kalhaven	Triogem		Zarn
	McAllister	Valiant		
	Midway	Vanguard		
	Mikado	Vedette		
	Newday	Veefreeze		
	N. J. 100	Vimy		
	N. J. 105	Wilma		
	N. J. 122	Yellow St. John		
		White Varieties		
Alton	Alexander		Hiley	Delicious
Belle of Georgia	Carman		Schumaker	Florence
Erly-Red-Fre	Champion			Greensboro
Pioneer	Cumberland			Kathryn
	Governor Hogg			Nectar
	Lola Seedling			Polly
	Raritan Rose			Redrose
	Rosebud			
	White Hale			

*Titratable acid calculated as malic acid. Low up to 0.50 per cent; medium from 0.51 to about 0.77; high 0.78 per cent or higher.
†See footnote to Table 2, page 7.

Ascorbic acid

During the three years, ascorbic acid varied from 4.8 to 23.4 mg per cent for the yellow varieties and from 6.0 to 26.0 mg per cent for the white varieties. The overall three-year average for the yellow varieties amounted to 9.5 mg per cent and for the white varieties 11.1 mg per cent. It is quite likely that sunlight affects the ascorbic acid content of peaches as it does that of tomatoes and strawberries (5, 9). If true, the great variation from season to season could be explained.

Carotene

During the three years the carotene content of the yellow varieties varied from 280 mcg to 1,380 mcg per cent. The overall three-year average amounted to 720 mcg per cent.

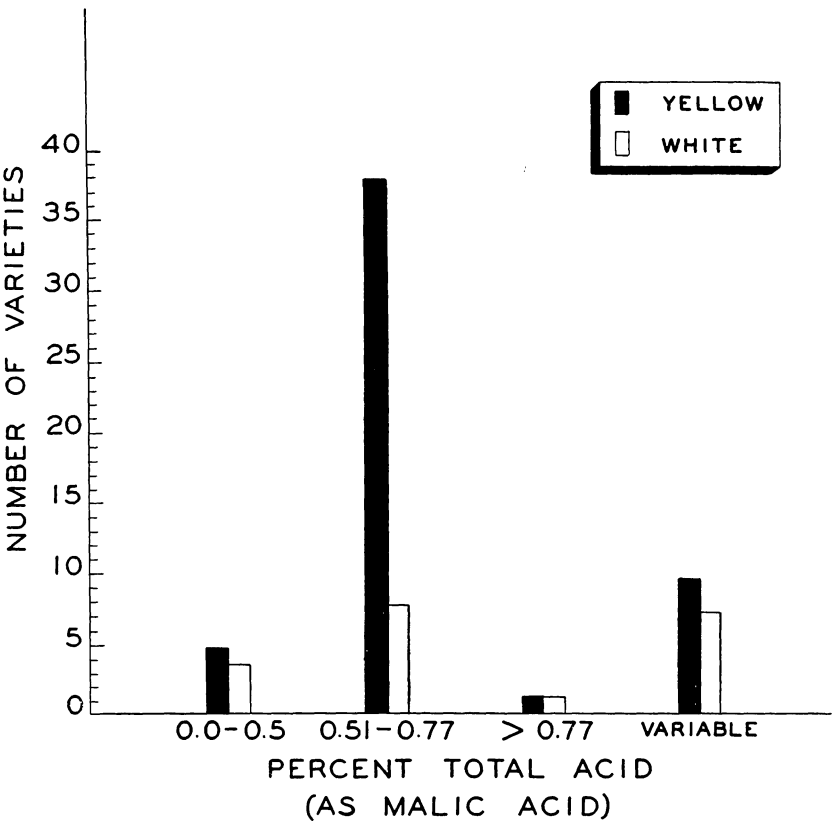

FIG. 1.—*Acid content of peaches by groups.*

pH and acidity

A classification of the peaches on the basis of the acid content, as a result of the three-year study, is given in Table 3 and Fig. 1. It is possible that a longer study would alter this list somewhat. In this table, those varieties classed as low in acid contained up to 0.50 per cent of titratable acid calculated as malic acid; those rated medium, from 0.51 to about 0.77 per cent; and those classed as high 0.78 per cent and higher.

During the three years, the pH varied from a low of 3.35 to a high of 4.12 for the yellow varieties, and a low of 3.31 to a high of 4.00 for the white varieties. The three-year average for the yellow peaches was 3.73 and for the white peaches 3.66.

The minimum titratable acidity for any one variety, calculated as

malic acid, for the three-year period for the yellow varieties was 0.34 per cent, the maximum being 0.92 per cent. The minimum for the white varieties was 0.39 per cent, the maximum 0.90 per cent. During this period the average titratable acid for the yellow varieties was 0.58 per cent and for the white varieties 0.59 per cent.

Soluble solids

Wide variation was found during the three years' study in the soluble solids, as indicated by the Brix reading. The three-year minimum and maximum values for soluble solids are 5.5° and 15.2° Brix for the yellow varieties and 6.9° and 14.4° Brix for the white varieties. The three years' average for the yellow peaches was 10.7° Brix and for the white peaches 10.1° Brix.

Total solids were determined only during the final, or 1947, season. The figures for yellow peaches for this year varied from 7.4 to 13.2 per cent. The total solids of the white peaches varied from 8.3 to 11.7 per cent. The average for the yellow varieties was 10.7 per cent and for the white varieties 9.7 per cent.

Organoleptic tests

Some variation was found from year to year in the grades assigned by the taste panel to different varieties of peaches processed for freezing. McAllister, Champion, Polly, Morse No. 1, N. J. 128, Ideal, Midway, Eclipse, J. H. Hale, and Viceroy were frequently in or near the group classed as best for freezing when grown under New York conditions. Halehaven has been given a lower rating because of lack of flavor in the thawed product. For the year 1947, the following varieties were placed in the good grade: N. J. 128, McAllister, Fair Beauty, Oriole, Vedette, Goldfinch, Belle of Georgia, Summercrest, and July Elberta. Those ranked as fair were Hardee, Golden Beauty, Alexander, Golden Globe, Arp, and Triogem. The others, including Elberta, were intermediate, and were grouped as fair +. These can be found in the 1947 column of Table 2. In this particular year, J. H. Hale was near the top of the fair + group, but in 1945 and 1946 it was in the good group.

In general, it was noted that when ascorbic acid was used in the processing, the scores, especially for flavor and color, were considerably higher than corresponding samples which were covered with sugar sirup only. When a mixture of citric acid and ascorbic acid was used to control darkening, the flavor was in most cases adversely affected in the direction of excessive tartness. As a result, the taste panel gave significantly lower scores to these samples. This statement applies to peaches

grown under New York conditions. It seems, therefore, that ascorbic acid alone preserved the color satisfactorily, which is in agreement with the results obtained by Ross, Bartlett, and Hard (11). The additional citric acid added nothing and at the same time its adverse affects on flavor rendered its use inadvisable at the level used in these experiments.

It appears that there is no relationship between freezing adaptability of peaches and the several chemical components studied.

Summary

1. No relation was found between the freezing adaptability of a peach variety and its ascorbic acid and carotene contents, soluble solids, free acids, and pH. Some other chemical factor may well affect the freezing adaptability of a peach variety.
2. Under western New York conditions the best yellow peaches for freezing among widely grown commercial varieties were J. H. Hale and Midway. McAllister, which received the highest rating of all varieties tested, Morse No. 1, N. J. 128, Ideal, Eclipse, and Viceroy among less well-known kinds also rated high for freezing adaptability. All of these were better than Elberta, although the latter gave a fairly good frozen product.
3. The outstanding white varieties were Champion and Polly.

Literature Cited

1 Blake, M. A. Additional studies of the acidity and tannin content of mature peach fruits. *Proc. Amer. Soc. Hort. Sci.,* **40,** *153–156. 1942.*

2 ———— and Davidson, O. W. Some results of acidity and catechol tannin studies of peach fruits. *Proc. Amer. Soc. Hort. Sci.,* **39,** *201–204. 1941.*

3 Chatfield, Charlotte, and Adams, Georgian. Proximate composition of American food materials. *United States Dept. Agr. Circ. No. 549. 1940.*

4 Culpepper, C. W., and Caldwell, J. S. The canning quality of certain commercially important eastern peaches. *United States Dept. Agr. Tech. Bul. No. 196. 1930.*

5 Hamner, K. C., Bernstein, L., and Maynard, L. A. Effects of light intensity, day length, temperature, and other environmental factors on the ascorbic acid content of tomatoes. *Jour. Nutrition,* **29,** *85–97, 1945.*

6 Lee, F. A., and Tukey, H. B. Chemical changes accompanying growth and development of seed and fruit of the Elberta peach. *Bot. Gaz.,* **104,** *348–355. 1942.*

7 Mackinney, G. Carotenoids of the peach. *Plant Physiol.,* **12,** *216–218. 1937.*
8 Nelson, E. K. The non-volatile acids of the peach. *Jour. Amer. Chem. Soc.,* **46,** *2337–2338. 1924.*
9 Robinson, W. B. The effect of sunlight on the ascorbic acid content of strawberries. *Jour. Agr. Res.,* **78,** *257–262. 1949.*
10 ———— and Stotz, Elmer. The indophenol-xylene extraction method of ascorbic acid and modifications for interfering substances. *Jour. Biol. Chem.,* **160,** *217–225. 1945.*
11 Ross, Edward, Bartlett, D. S., and Hard, Margaret M. An application of oxidation-reduction potentials to frozen fruits treated with ascorbic acid and ascorbic-citric acid mixtures. *Food Technol., 7, 153–156. 1953.*
12 Schroder, G. M., Satterfield, G. H., and Holmes, A. D. The influence of variety, size, and degree of ripeness on the ascorbic acid content of peaches. *Jour. Nutrition,* **25,** *503–509. 1943.*
13 Thaler, H., and Schulte, K. E. Die Carotinoide der gelben Pfirsiche. *Biochem. Zeitschr.,* **306,** *1–5. 1940.*
14 The Association of Vitamin Chemists. Methods of vitamin assay. *New York: Interscience Pub., Inc. Ed. 2. 1951.*
15 Tressler, D. K., and DuBois, C. No browning of cut fruit when treated by new process. *Food Ind.,* **16,** *No. 9, 75, 137–139. 1944.*
16 Western Canner and Packer. Statistical review and yearbook. *Number 45, 6, 195. May 25, 1953.*