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BLUEBERRY CULTIVARS FOR FROZEN PIES *

by

J. F. Gallander, W. A. Gould, and H. Stammer

Although blueberries are quite easily preserved by freezing, their quality may vary after thawing. One of the most important factors affecting the quality of the frozen product is the blueberry cultivar or variety. The most desirable characteristics are: tender skin, large skin, distinctive flavor, and natural color retention.

A study was initiated at the Research Center to determine the suitability of several blueberry cultivars for frozen pies as related to the flavor of the finished product. The results are used as a guide for recommending the best cultivars for freezing to growers, processors, and consumers.

PROCEDURE

During the 1967 season, fruit was obtained from eight blueberry cultivars grown in the horticultural plots at the Research Center. The berries of each cultivar were washed, drained, sorted, and packaged in moisture - vaporproof containers. The filled containers were placed in - 15°F. storage and held at this temperature for 6 months.

After the storage period, the berries were partially thawed and used in a standard pie recipe. The crust and ingredients, as well as the amount of each ingredient, were essentially the same for each pie. The formula used for the blueberry pie filling was as follows:

	Per Eight - Inch Pie	
	Percent	Ounces
Frozen blueberries	53.86	8.62
Sugar	26.93	4.31
Water	16.16	2.59
Waxy maize starch	2.69	0.43
Salt	0.36	0.06

After the pies were prepared, they were frozen and stored in a freezer at - 15°F.

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*This article was taken in part from the Research Summary 27, 1968, OARDC.

EVALUATION

After a storage period of 6 weeks, the pies were baked and presented to a 10 member taste panel for evaluation. Each panelist was asked to score the pies for flavor on a hedonic scale of 1 through 9 (9 being the most acceptable). The pies were identified by code letters and the evaluation was repeated three times on different days.

In addition to the taste panel evaluation, chemical analysis were performed on the raw fruit of each cultivar. The following were determined: free acids (as citric), pH, and soluble solids.

DISCUSSION OF RESULTS

The blueberry cultivars were listed according to their flavor scores (Table I). The cultivar Jersey was rated highest, 6.93, by the taste panel and was considered the best cultivar for frozen blueberry pie. Since Jersey is a major cultivar grown in Ohio, it was used as a standard to statistically compare the flavor scores of the other cultivars.

The flavor scores of three cultivars, June, Coville, and Bluecrop, were found to be significantly lower than Jersey. Therefore, these cultivars are not recommended for manufacturing high quality frozen pies. The other cultivars were rated high in flavor and the taste panelists also indicated that the cultivars possessed good color and texture.

The cultivar June was found to be highest in pH, 3.60, and lowest in total acids, 0.28 percent (Table I). In contrast, Bluecrop was lowest in pH, 2.65, and its total acid content, 1.27 percent, was one of the highest tested.

The soluble solids varied from 11.0 to 16.2 percent, represented by the cultivars June and Coville. For the soluble solids - acid ratios, June was highest (39.4) and Bluecrop lowest (9.8). An interesting note is that June and Bluecrop were also rated low in flavor. The results indicate a possible relationship between the soluble solids - acid ratios and flavor scores of the pies. Cultivars with relatively high (sweet) or low (tart) soluble solids - acid ratios tend to be scored low in flavor.

SUMMARY

In general, the majority of cultivars evaluated in this study are acceptable in flavor for frozen pies. However, certain cultivars tend to have better flavor and the recommended cultivars are: Jersey, Berkeley, Earliblue, and Concord.

TABLE I CHEMICAL COMPOSITION OF SEVERAL FRESH BLUEBERRY CULTIVARS AND FLAVOR EVALUATION OF FROZEN BLUEBERRY PIES, 1967 SEASON.

Cultivar	Flavor Score	pH	Soluble Solids %	Total Acidity as Citric Acid %	Soluble Solids Acid Ratios
Jersey	6.93	2.80	12.8	0.68	18.8
Berkeley	6.89	3.25	12.6	0.66	19.1
Earliblue	6.69	2.80	12.8	0.78	16.4
Concord	6.68	3.00	14.1	0.80	17.7
Atlantic	6.33	3.20	15.7	0.98	16.0
June	6.03*	3.60	11.0	0.28	39.4
Coville	5.53*	3.00	16.2	1.42	11.4
Bluecrop	5.13**	2.65	12.4	1.27	9.8

*Significantly different at the 0.05 level from the standard cultivar, Jersey, for flavor.

**Significantly different at the 0.01 level from the standard cultivar, Jersey, for flavor.

GRAPE CULTIVARS FOR JELLY MAKING *

by

J. F. Gallander, W. A. Gould and G. A. Cahoon

This report deals with the results of a preliminary study concerning the processing suitability of several of the newer grape cultivars for making jelly.

New cultivars offer the possibility of producing a high quality grape jelly, both commercially and on a home scale, in districts were Concord is not grown extensively. With these considerations in mind, 11 grape cultivars grown under Southern Ohio conditions were evaluated in 1967 for their quality after manufacturing into jelly.

The fruit from each cultivar was washed, destemmed, crushed, and heated to 145°F. for color extraction. The hot crushed grapes were then pressed, and the extracted juice was immediately placed in freezer storage (-15°F.). After two months of storage, the juice was thawed and filtered to remove the insoluble material formed during freezing. This clarified juice was then processed into a pure fruit jelly.

The formula used in making the grape jelly was based on a 45 - 55 ratio (45 pounds of fruit juice to each 55 pounds of sugar). A measured amount of grape juice for each jelly was placed in a steam kettle and heated. The required amount of slow-set pectin, sugar and citric acid was added to the juice at the proper time during processing. Each batch was allowed to boil until the desired temperature was obtained, 9°F. above the boiling point of water. After this temperature was reached, the hot juice was poured into glass containers and capped.

After approximately two months of storage, the jellies were evaluated for flavor by a 20 member taste panel. The jellies were identified only by code numbers and each panelist was asked to score the jellies on a preference scale of 1 through 9 (5 and above being acceptable). This evaluation was repeated twice for each jelly, which included 11 grape cultivars and two commercial grape jellies.

Both commercial jelly samples (commercial No. 1 and No. 2) were rated higher in flavor than most of the other jellies, (Table I). Since these samples were manufactured from the cultivar Concord, the high rating of 7.2 was expected and received for this study's Concord jelly. Results indicated that any one Concord jelly was as good in flavor as the others.

A major finding of this investigation was that two cultivars, Fredonia and Kendaia, were comparable in flavor to Concord jellies. The taste panel rated the Fredonia jelly 6.9 and Kendaia 6.8. These scores were not significantly lower than Concord samples

*This article was taken in part from the May-June issue of the Ohio Report, OARDC.

TABLE I FLAVOR EVALUATION OF SEVERAL GRAPE JELLIES

Cultivar	Flavor Score
Commercial No. 1	7.2
Commercial No. 2	6.9
Concord	7.2
Fredonia	6.9
Kendaia	6.8
Van Buren	5.7
Bath	5.6
Sheridan	5.4
N.Y. 18080	5.4
Steuken	5.1
Yates	5.1
Alden	5.0
Schuyler	4.9

The color of the jellies was bright and attractive, with Fredonia possessing a blue color similar to Concord, and Kendaia a reddish blue.

Jellies made from Van Buren, Bath, Sheridan, and N.Y. 18080 were rated acceptable by the taste panel. However, the flavor scores were significantly lower than the commercial samples, and therefore the cultivars were not considered as good as Concord, Fredonia, and Kendaia. The other cultivars, Steuben, Alden, Yates and Schuyler were ranked low and were considered doubtful in acceptability.

EVALUATION OF VARIOUS GRAPE CULTIVARS FOR PROCESSING III. TABLE WINES

by

J. F. Gallander

During the 1967 season, fourteen grape cultivars were processed and evaluated for their suitability in manufacturing table wines. The cultivars used in this study were grown at the Southern Branch of the Ohio Agricultural Research and Development Center in Ripley, Ohio. Each cultivar was harvested at maturity and transported to the Department of Horticulture in Wooster, Ohio, for processing.

Before the fermentation was initiated, a representative sample of each received grape cultivar was analyzed for the following:

1. pH. The pH was determined by the glass electrode method (Beckman Zeromatic pH meter) using 10 ml. of grape juice diluted with 90 ml. of distilled water.

2. Total Acids. A 10 ml. grape juice sample was titrated with a 0.1 normal sodium hydroxide solution to a pH of 8.2. The percent total acids was calculated as tartaric.

3. Total Soluble Solids. The soluble solids content was determined by using an Abbe refractometer.

4. Total Sugars. The total sugar content of the grapes was determined by the Lane and Eynon procedure and was expressed as reducing sugars.

For the raw juice, the percent total acids varied widely with Seibel 7053 having the highest percent, 1.65 and Steuben the lowest, 0.53 (Table I). The cultivars highest in percent soluble solids were: Baco #1 (20.0) and Golden Muscat (19.8).

After the analysis of the raw product, each grape cultivar was fermented by a standard procedure. The received grapes were stemmed, crushed and treated with 100 ppm SO_2. Then, sugar was added to the crushed grapes to bring the original soluble solids content to 22 percent. After 24 hours, an active yeast culture was added, and the fermenting grapes were stirred twice daily. The fermenting white grapes were pressed 24 hours after yeast inoculation, while the blue and red musts were pressed 4 days after yeast was added. After pressing, the grape must of each cultivar was divided into two lots. One lot was directly transferred to glass carboys and represented wine with no amelioration (0% amelioration). Before transferring to carboys, the other lot was ameliorated to 30 percent by weight with 22 percent - sugar syrup (30 % amelioration). All carboys were equiped with "water seals", and the fermentations were completed in approximately 3 weeks. The wines were racked several times over a 3 months period and then bottled.

After one month storage (34°F.), the wines were analyzed for various chemical constituents and evaluated organoleptically (Table II). The following chemical constituents were determined:

1. Total Acids: The wine was titrated with a 0.1 normal sodium hydroxide solution to a pH of 8.2. The percent total acids was calculated as tartaric.

2. Total Sugars: The total sugar content of the wines was determined by the Lane and Eynon procedure and was expressed as reducing sugars.

3. Alcohol: The alcohol content was determined by using an ebullioscope, Dujardin - Salleron Type.

4. Tannin: The tannin content was determined by using the standard (Pro) procedure.

5. Extract: The extract of the wines was determined by taking the density of a dealcoholized sample.

In general, all wines were low in sugar content and were considered dry. The pH and alcohol content of wines with no amelioration were lower than those wines ameliorated to 30 percent. In contrast, the content of the other constituents was decreased when the wine was ameliorated. The results of the organoleptic evaluation indicated that the ameliorated wines were best and cultivars Seikel 5279, Seikel 9549, Seibel 10878, Couderc 7120 and S.V. 12375 were considered superior in overall quality.

TABLE I COMPOSITION OF VARIOUS GRAPE CULTIVARS, 1967 SEASON

Cultivar	Harvest	Color	pH	Total Acids %	Soluble Solids %	Total Sugars %
Schuyler	Aug. 8	Blue	3.40	0.62	16.1	15.3
Seibel 5279	Aug. 16	White	3.30	1.01	16.3	14.5
Seibel 9549	Aug. 21	Blue	3.15	1.33	15.1	13.0
N.Y. 18080	Aug. 30	Red	3.45	0.63	14.4	9.5
Seibel 7053	Sept. 6	Blue	3.10	1.65	15.7	14.7
Couderc 17	Sept. 6	Blue	3.40	0.68	14.7	13.6
Steuben	Sept. 6	Blue	3.35	0.53	17.5	12.2
Bokay	Sept. 12	White	3.20	0.98	14.2	12.7
Golden Muscat	Sept. 12	White	3.20	0.91	19.8	17.5
Seibel 10878	Sept. 12	Blue	3.15	1.23	15.8	13.5
S.V. 12375	Sept. 18	White	3.20	1.20	17.0	14.9
Blue Eye	Sept. 18	Blue	3.15	0.98	14.2	12.5
Couderc 7120	Sept. 18	Blue	3.10	1.01	16.7	14.8
Baco #1	Sept. 18	Blue	3.50	1.34	20.0	18.7

TABLE II COMPOSITION OF WINES FROM VARIOUS GRAPE CULTIVARS, 1967 SEASON

Cultivars	Percent Amelioration	Total Sugars %	pH	Total Acids %	Alcohol %	Extract Gms. Per 100 ml.	Tannin Mgs. Per 100 ml.	Description
Schuyler	0	0.08	3.05	0.64	13.2	1.2	50	thin, weak,
	30	0.12	3.20	0.55	13.8	1.0	38	poor
Seibel 5279	0	0.10	3.25	0.79	13.3	1.5	33	neutral, fruity
	30	0.11	3.30	0.61	13.6	1.1	26	
Seibel 9549	0	0.08	3.05	0.91	13.6	1.8	94	good aroma and
	30	0.13	3.10	0.71	13.9	1.5	69	flavor
N.Y. 18080	0	0.08	3.35	0.56	13.6	1.3	55	perfumey and
	30	0.04	3.40	0.48	14.3	1.1	36	unusual
Seibel 7053	0	0.10	3.20	0.79	14.0	1.8	103	good body
	30	0.11	3.20	0.64	14.2	1.5	77	and aroma
Couderc 17	0	0.11	3.30	0.61	13.4	1.6	38	fruity and
	30	0.12	3.35	0.47	13.8	1.3	28	thin
Steuben	0	0.05	3.00	0.71	12.7	1.3	79	fruity and
	30	0.19	3.05	0.59	13.5	1.2	61	light
Bokay	0	0.39	3.00	0.83	14.3	2.2	32	acid, not
	30	0.77	3.10	0.66	14.7	2.0	27	good
Golden Muscat	0	0.11	3.00	0.89	14.4	1.7	32	fair muscat
	30	0.12	3.15	0.73	14.6	1.2	27	
Seibel 10878	0	0.25	3.15	1.06	13.4	2.0	80	excellent flavor
	30	0.42	3.20	0.82	13.8	1.7	61	aroma

TABLE II (Continued)

Cultivars	Percent Amelioration	Total Sugars %	pH	Total Acids %	Alcohol %	Extract Gms. Per 100 ml.	Tannin Mgs. Per 100 ml.	Description
S.V.	0	0.11	3.20	0.79	13.2	1.7	35	good aroma
	30	0.07	3.25	0.63	13.7	1.3	26	and color
Blue Eye	0	0.07	3.00	0.98	13.1	1.7	65	acid and
	30	0.10	3.10	0.76	13.5	1.4	51	poor flavor
Couderc 7120	0	0.12	3.00	1.06	12.4	2.2	103	good aroma
	30	0.37	3.10	0.79	12.9	2.0	73	and odor
Baco #1	0	0.10	3.30	1.11	11.4	2.9	100	good color
	30	0.11	3.35	0.81	12.5	2.0	82	and fair aroma

EVALUATION OF SNAP BEAN CULTIVARS FOR PROCESSING

by

William Hildebolt and W. A. Gould

Eleven cultivars of snap beans were grown on the Horticultural Farm at The Ohio State University. The beans were planted in 200 foot rows, 36 inches apart with the seed placed two to three inches apart in the row.

The beans were harvested by hand and transported immediately to the Fruit and Vegetable Processing and Technology division Pilot Plant. They were prepared for canning and freezing. The beans were mechanically snipped, size graded, spray washed, steam blanched and hand packed twelve ounces into number 303 plain tin cans. Two size grades were used, 1-3 and 4-6, the latter were cut into pieces 1 to 1½ inches long, the smaller size grade were packed as whole beans. Blanch time varied from 2½ to 4 minutes depending on sieve size.

The beans for canning were covered with boiling distilled water and a thirty grain sodium chloride tablet was added to the can. The cans were exhausted for four minutes, steam flow closed at 15 psi and processed at 240°F. for 20 minutes.

Quality was determined as follows (the results as reported in the following tables are the average values were applicable):

<u>Number of plants</u> - The actual number of plants in 100 feet were pulled and counted for each of the harvests.
<u>Yield</u> - The beans were weighed to determine the gross yeild in pounds for the number of plants in 100 foot rows.
<u>Number of pods were pound</u> - The number of pods in a one pound field run sample was counted.
<u>Percent sieve size</u> - Sieve size was determined by measuring the diameter of the pod perpendicular to the sutures. The sieve sizes of a one pound field run sample were determined and weighed. The percentage of each sieve size was then calculated.
<u>Pod Length</u> - Pod length was determined by evaluating 20 pods as to minimum, maximum, and average length.
<u>Percent by weight seeds</u> - Determined on raw, canned and frozen products and reported in Tables I and II by sieve size. For determining percent by weight seeds, 100 grams of pods for each sieve size was deseeded and the seeds weighed.

The grade for the canned product by the respective attributes of quality was determined in accordance with the U.S. Standards for Grades of Canned Snap Beans. The actual score points assigned each of the attributes of quality were recorded by sieve size and harvest for each of the varieties as reported in Tables I and II.

TABLE I SNAP BEANS -CULTIVAR EVALUATION - 1968 - RAW PRODUCT DATA BY HARVEST 1, 2, and/or 3

								Pod Lengths in Inches								
	Sieve	No./lb.			% Seed			Minimum			Maximum			Average		
Cultivar	Size	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
Tempo 206	1	36	12		4.2	2.4		2.0	2.25		4.0	3.5		4.0	3	
	2	20	5		9.0	2.4		2.7	3.25		4.2	3.5		4.2	2.5	
	3	19	17		21.5	9.9		3.3	2.5		5.1	4.25		5.1	3.5	
	4	17	21		24.3	21.9		2.6	3.0		5.8	4.8		5.8	4.2	
	5	6	15		11.8	23.6		4.2	3.75		5.2	5.4		5.2	4.7	
	6	11	17		29.2	39.7		3.3	2.25		6.3	5.5		6.3	4.4	
Total		109	87													
G.P. 63-321	1	52	10	8	13.7	3.3	.91	1.5	2.5	2.2	4.1	4.3	3.2	3.2	3.8	3.0
	2	20	6	4	12.5	3.3	1.21	3.4	3.4	2.6	4.9	4.3	4.4	4.2	4.0	2.9
	3	22	9	6	18.7	8.3	2.12	3.1	3.2	2.7	5.7	4.8	4.5	4.9	4.2	3.0
	4	10	12	14	18.7	13.3	10.63	2.8	4.2	3.0	5.6	5.6	5.2	4.7	4.6	4.5
	5	6	14	17	16.3	14.2	21.27	6.2	4.1	3.3	5.3	6.2	6.0	5.6	4.8	4.5
	6	4	20	27	20.0	47.5	63.82	5.3	3.5	4.1	4.4	6.5	6.4	5.2	5.3	5.0
Total		114	71	76												
G.P. 64-489	1	19	8	4	9.7	2.8	.18	2.2	3.3	2.1	3.8	3.8	3.2	3.0	3.0	3.2
	2	23	5	2	15.0	2.8	.18	2.7	3.1	2.3	3.9	4.6	2.9	3.5	3.4	2.9
	3	27	4	7	22.6	4.7	1.98	2.7	3.9	2.7	4.3	4.6	3.9	3.9	4.0	3.9
	4	25	5	12	30.1	7.5	9.7	4.0	3.9	2.4	5.1	4.7	4.4	4.3	4.2	4.4
	5	9	14	28	18.3	20.6	27.3	4.6	3.8	2.4	5.0	6.0	5.2	4.5	4.6	5.2
	6	1	28	39	4.3	61.7	60.6	4.5	4.3	3.5	4.5	6.3	5.5	4.5	5.4	5.5
Total		104	64	92												

TABLE I SNAP BEANS - CULTIVAR EVALUATION - 1968 - RAW PRODUCT DATA BY HARVEST 1, 2, and/or 3

Cultivar	Sieve Size	No./lb. 1	No./lb. 2	No./lb. 3	% Seed 1	% Seed 2	% Seed 3	Pod Lengths in Inches: Minimum 1	Minimum 2	Minimum 3	Maximum 1	Maximum 2	Maximum 3	Average 1	Average 2	Average 3
G.P. 488	1	13	16	3	3.6	2.46	.52	2.2	2.3	3.0	3.8	4.1	3.8	3.0	2.7	3.6
	2	9	7	2	5.5	2.46	1.0	2.8	2.8	3.1	4.5	5.0	3.6	3.7	4.0	--
	3	26	9	6	18.2	6.16	2.1	2.5	3.0	3.0	4.8	5.0	4.4	4.2	4.3	3.5
	4	23	16	12	28.2	16.6	6.3	4.0	3.7	2.7	5.0	5.5	4.7	4.3	4.9	3.9
	5	11	32	21	20.0	41.7	26.2	4.2	3.6	3.1	5.5	5.4	5.4	5.0	5.2	4.8
	6	6	10	27	24.5	30.8	63.8	3.9	4.3	3.6	5.5	5.9	6.0	4.9	5.0	5.0
Total		88	90	71												
G.P. 64-478	1	10	5	7	3.9	.47	.73	1.6	2.0	2.0	3.5	2.8	3.1	2.6	2.7	2.2
	2	11	7	6	7.0	1.88	1.09	2.0	2.4	2.5	4.0	3.5	3.9	3.6	3.2	3.5
	3	29	16	5	19.7	10.37	1.83	3.2	3.0	2.3	4.4	4.9	4.2	4.0	4.2	3.4
	4	25	25	24	25.9	21.22	12.3	2.9	2.8	2.7	4.9	5.1	5.0	4.5	4.3	3.8
	5	22	32	21	38.5	50.94	22.5	2.9	3.7	2.5	5.2	5.3	5.0	4.6	4.3	4.2
	6	1	6	30	4.7	15.09	61.5	3.5	2.7	2.8	3.5	5.0	4.9	3.5	4.5	4.5
Total		98	91	93												
Dark Earligreen 66-312	1	46	13		9.0	3.0		2.4	1.8		4.5	4.4		3.7	4.1	
	2	24	8		12.3	3.6		1.9	3.4		4.5	4.4		3.7	4.0	
	3	17	16		16.4	15.1		4.2	3.6		5.5	5.4		4.8	4.7	
	4	22	37		42.6	53.6		3.9	4.0		5.8	5.5		5.1	4.8	
	5	4	11		19.7	24.7		4.7	4.0		5.7	6.0		5.5	5.0	
	6	--	0													
Total		113	85													

TABLE I SNAP BEANS - CULTIVAR EVALUATION - 1968 - RAW PRODUCT DATA BY HARVEST 1, 2, and/or 3

Cultivar	Sieve Size	No./lb. 1	No./lb. 2	No./lb. 3	% Seed 1	% Seed 2	% Seed 3	Pod Lengths in Inches: Minimum 1	Minimum 2	Minimum 3	Maximum 1	Maximum 2	Maximum 3	Average 1	Average 2	Average 3
G.P. Tender-crop # 64	1	71	17		17.2	2.6		2.5	1.1		4.0	3.4		3.3	2.7	
	2	26	8		18.3	5.2		3.7	3.1		4.3	4.1		4.1	3.5	
	3	17	16		17.2	11.9		3.7	1.7		5.0	4.1		3.8	3.7	
	4	10	37		15.0	40.2		4.0	2.0		4.9	4.7		4.3	4.2	
	5	9	16		14.4	25.8		3.7	3.5		4.9	5.5		4.7	5.1	
	6	3	3		12.9	14.4		4.8	2.9		5.6	5.1		5.4	4.8	
Total		136	97													
Tendercrop # 83	1	14	7		3.0	.23		2.5	1.7		3.6	3.0		3.2	2.8	
	2	11	1		3.0	.69		2.9	3.4		3.8	3.4		2.7	3.4	
	3	8	8		3.9	3.9		2.8	2.2		4.1	4.4		3.1	3.6	
	4	16	18		9.9	15.6		3.2	3.0		4.5	4.6		3.6	3.4	
	5	19	21		21.9	22.1		3.0	3.6		4.8	6.1		4.4	4.3	
	6	26	24		58.4	50.5		3.2	3.7		5.5	5.3		4.8	4.5	
Total		94	69													
Sparton Arrow # 76	1	1	0		0.21			4.2			4.2			4.2		
	2	1	1		.10	.08		3.6	3.7		3.6	3.7		3.6	3.7	
	3	2	3		.54	1.42		3.7	4.0		3.1	4.6			4.1	
	4	9	6		5.63	3.56		3.2	3.8		5.5	4.8		4.6	3.7	
	5	22	28		25.4	33.77		4.5	4.4		6.5	6.5		5.0	5.7	
	6	29	30		68.1	61.14		2.8	3.5		6.7	6.9		5.2	5.5	
Total		64	68													

TABLE I SNAP BEANS - CULTIVAR EVALUATION - 1968 - RAW PRODUCT DATA BY HARVEST 1, 2, and/or 3

Cultivar	Sieve Size	No./lb. 1	No./lb. 2	No./lb. 3	% Seed 1	% Seed 2	% Seed 3	Pod Length in Inches: Minimum 1	Minimum 2	Minimum 3	Maximum 1	Maximum 2	Maximum 3	Average 1	Average 2	Average 3
Tenderette 81	1	8	4		1.4	.27		1.9	2.1		3.8	3.4		3.1	2.4	
	2	4	1		.90	.27		3.0	4.0		3.6	4.0		3.2	4.0	
	3	5	5		2.7	1.9		3.2	3.1		4.1	3.6		3.6	3.5	
	4	6	10		4.5	7.9		3.3	3.5		4.9	4.5		3.9	3.8	
	5	12	10		13.5	7.7		3.5	3.0		4.8	5.0		4.7	3.9	
	6	35	42		77.0	81.8		2.3	3.1		6.0	6.0		4.7	4.9	
Total		70	72													
Astro	1	10	8			2.3		2.2	1.0		3.2	5.5		2.8	4.5	
	2	30	3			2.3		2.5	4		4.0	5.0		3.7	4.75	
	3	20	12			8.7		3.0	3.5		5.0	4.8		4.1	4.3	
	4	21	13			14.5		3.2	2.7		5.3	5.5		4.5	4.6	
	5	15	27			43.9		4.3	3.4		6.7	5.9		4.7	5.1	
	6	2	11			28.3			4.5		5.5	5.7			5.1	
Total		98	74													

TABLE II 1968 SNAP BEAN CULTIVAR EVALUATION CANNED PRODUCT

Cultivar	No. Plants /100 ft.	Lbs. Yield /100 ft.	Style	Sieve Size	Liquor	Color	U.S.D.A. Grade Factors: Abs. of Defects	Character	Total Score	Grade
Tempo 206	449	36	Whole	1-3	8.5	14	35	34.5	92	B
			Cut	4-6	7.5	12.5	35	35	90	B
G.P. 63-321	382	36	Whole	1-3	9	13	35	37	94	A
			Cut	4-6	8.3	11.3	35	36.6	91	A
G.P. 64-489	332	40	Whole	1-3	9	12	35	36	96	A
			Cut	4-6	8.6	11	35	36	91	C
G.P. 488	215	30	Whole	1-3	8.3	12.6	35	36	92	A
			Cut	4-6	8.5	11	35	38	92	C
G.P. 64-478	266	37	Whole	1-3	8.6	13.3	35	36.3	93.3	A
			Cut	4-6	6.6	13.3	35	36.6	92.6	A
Dark Earligreen 66-312	352	37	Whole	1-3	8.5	11.5	35	37	92	A
			Cut	4-6	7.5	11.5	35	36.5	90.5	A
G.P. Tendercrop # 64	328	38	Whole	1-3	9	14	35	35.5	93.5	A
			Cut	4-6	8.5	12.5	35	35	91	B
Tendercrop # 83	245	42	Whole	1-3	9	13.5	35	38.5	96	A
			Cut	4-6	3	10.5	35	38.5	88	D
Sparton Arrow # 76	154	43	Whole	1-3	5.5	13	35	38	91.5	D
			Cut	4-6	3.5	10	35	38	86.5	D
Tenderette 81	227	46	Whole	1-3	8.5	13	35	36.5	93	A
			Cut	4-6	5.5	11	35	37.5	89	D
Astro	267	29	Whole	1-3	9	12.5	35	36.5	93	A
			Cut	4-6	9	12.5	35	36	92.5	A

KRAUT SNACKS

by

J. R. Geisman

Many recipes are available for sauerkraut hors d' oeuvres. These products, while requiring elaborate preparations, usually have an excellent and highly desirable flavor. Many of these items are sauteed or deep fat fried. If a product could be developed which could be simply prepared with a desirable flavor, the resultant product could be produced commercially as a snack item.

Investigations were undertaken to develop a kraut product which could be shaped or molded and deep fat fried. Initial experiments indicated that reconstituted instant mashed potatoes were excellent for a molded product. It was found that the potatoes were of ideal consistency if they were reconstituted with about 2/3 of the water recommended. When the potatoes thus prepared were combined with kraut in varying proportions, a mixture of 3 parts by weight chopped kraut to 1 part by weight potatoes produced the most desirable flavor. Although the mixture could be molded, when it was deep fat fried, the product partially disintegrated.

Further studies were conducted to evaluate certain binders for use in this type product. The materials evaluated and the percent by weight are shown in Table I.

It should be pointed out that the conditions for evaluations were kept constant. The frying temperature was 350°F., peanut oil was used as the frying medium and the frying time was five minutes. The products were mixed and shaped into spheres approximately 1 inch in diameter.

The results indicated that two additives would serve as a binder in this type product. One was a modified starch (Keojel) at 5% and the other Kelcoloid HV at either 1½ or 2%. The product could be flavored in any manner the processor deemed acceptable. The resultant snacks would open a new avenue for using sauerkraut.

TABLE I RATING OF ADDITIVES USED AS BINDERS IN DEEP FAT FRIED KRAUT SNACKS WITH PERCENT BY WEIGHT USED

Additive	Percent Used	Rating [a]
Carboxy Methyl Cellulose	4	1
Carboxy Methyl Cellulose	2	3
Carboxy Methyl Cellulose	1	4
Carboxy Methyl Cellulose	½	1
Klucel (Starch)	4	4
Klucel (Starch)	2	1
Klucel (Starch)	1	1
OK Keojel (Starch)	5	5
Superclear (Starch)	5	1
Kelgin	1½	1
Kelcoloid HV	1	4
Kelcoloid HV	1½	5
Kelcoloid HV	2	5

a = ratings were made on the following scale:

1 = Complete disintegration
2 = Partial disintegration
3 = Slight disintegration
4 = No disintegration
5 = No disintegration + Browned outside

MECHANICAL HARVESTING AND BULK HANDLING EVALUATION OF TOMATO CULTIVARS FOR PROCESSING

by

W. A. Gould, Jonnie Budke, Carol Foglesong and Louise Howiler *

The 1968 processing tomato project included 8 cultivars of tomatoes which were grown in replicated plots under acceptable commercial practices at the Ohio Agricultural Research and Development Center - Northwestern Branch, Hoytville, Ohio. Each cultivar was machine harvested (with FMC Western Model) 2 or more times, and bulk handled in 400 pound lots, either dry, in water, or in water containing 500 ppm chlorine dioxide. Following harvest the tomatoes were transported by truck (approximately 100 miles) to the Ohio State University, Columbus, Ohio for processing. All lots were processed after 12, 24, and 48 hours hold after harvest.

QUALITY EVALUATION

1. Percent total acid as citric. The sample (raw or canned) used for pH determination was directly titrated using 0.1 Normal Sodium Hydroxide solution to a pH of 8.1. Calculations using the following equation were made:

$$\% \text{ acid} = \frac{(\text{No. of ml. of 0.1 N NaOH})\ (.0064)}{10 \text{ ml. sample}} \times 100$$

2. pH. The pH was determined by the glass electrode method (Beckman Zeromatic pH meter) using 10 ml. of tomato juice (raw or canned) diluted with 90 ml. of distilled water.

3. Juice Color. Agtron F samples of raw or canned tomato juice were presented to the Agtron F instrument in a standard plastic sample cup. The instrument was standardized, using a black plastic plate (Monsanto Lustrex 11250) as 70. Readings were taken directly.

4. Percent soluble solids. An Abbe 3L refractometer was used for direct determinations of percent soluble solids on raw or canned juice. The instrument was standardized with distilled water and all readings converted to 20°C. No correction is made for salt.

* Assistance of W. N. Brown, Vegetable Crops Division; Clair Zimmerman, James Trotter and staff, Northwestern Branch OARDC; and the Processing and Technology Students -- Marshall Bash, David Crean, Richard Dafler, Ronald Gould, Fred Green, Carol Gutheil, William Hildebolt, Larry Johnson, Connie Link, Loren Lucas, John Mount and T. P. Umana is gratefully acknowledged.

5. Grades of Canned Tomatoes. The grade was determined in accordance with the U.S. Standards for Grades of Canned Tomatoes.

6. Grades of Canned Tomato Juice. The grade was determined in accordance with the U.S. Standards for Grades of Canned Tomato Juice.

7. Viscosity. The viscosity was measured using the GOSUC efflux tube instrument containing a 5/64" opening and standardized at 32 seconds at 25°C. with water. The rate of flow from the instrument was measured with a stop watch and the readings recorded directly.

8. Raw tomato cut surface color. A random sample of 20 raw tomatoes were cut in half and color measured on the Agtron E instrument. The "E" values reported are an average for the 20 tomatoes.

9. Vitamin C. Ten ml. aliquots of tomato juice were diluted with 90 ml. of 1% meta phosphoric acid and filtered. A 10 ml. aliquot of the filtrate was titrated with 0.2% 2, 6-dichlorophenolindophenol indicator solution. Milligrams of vitamin C were determined by the following formula:

$$\text{Dye factor} \times \text{ml. of dye} \times 100 = \frac{\text{mgm. Vit. C}}{100 \text{ gms.}}$$

PREPARATION AND PROCESSING

All tomatoes were prepared and processed as either whole tomatoes or tomato juice according to acceptable commercial practices in the OSU Pilot Plant.

Each lot of whole tomatoes was filled to 10.5 - 11.0 oz. in No. 303 plain tin cans.

RESULTS

The results are presented in Tables I and II.

SUMMARY

XP 627	Fruits are small, oval shaped, green shoulders, canned product average quality, but must be cored.
H 14456	Round, large size, green shoulders, average canned product quality, but core must be removed.
Bouncer	Large fruit, oblong, green shoulders, some radial cracking, low soluble solids, low total acids, outstanding wholeness quality for canned product. Only serious problem is green shoulder which was scored down on canned product, otherwise Fancy product. Product must be acidified. The best cultivar for holding characteristics.
LaBonita	Very small fruit, round, green shoulders, too soft for peeled tomato quality if held beyond 12 hours. Tomatoes must be cored.
68624	Irregular shape - oval to oblong, too soft under most conditions of handling for peeled tomato quality.
Chico Grande	Pear shaped, medium size, low total acid content, excellent wholeness quality when handled under dry conditions.
Harvester	Pear shaped, medium to small size, low total acid content. Excellent peeled tomato quality. Product should be acidified.
Heinz 14451	Medium size, pear to oblong shape, high soluble solid content. Excellent peeled tomato quality. Product should be acidified.

TABLE I. 1968 RAW PRODUCT TOMATO CULTIVARS EVALUATION-
OBJECTIVE QUALITY AND CHEMICAL ANALYSIS

<u>Average Values</u>

Cultivar	Holding Treatment	Hold Time	% Soluble Solids	% Total Acids	pH	Vitamin C	Agtron F	Agtron E
XP 627	Water	12	5.0	.320	4.4	19.39	45	
		24	5.2	.371	4.4	26.95	54	
		48	5.1	.365	4.4	19.98	56	
		$\bar{x}$	5.1	.352	4.4	22.11	51.7	
	Solution	12	4.8	.416	4.4	16.62	51	
		24	4.7	.371	4.4	23.10	45	
		48	4.6	.371	4.4	16.65	50	
		$\bar{x}$	4.7	.386	4.4	18.79	48.7	
	Dry	12	5.1	.371	4.3	16.62	52	
		24	4.6	.314	4.4	26.95	52	
		48	4.9	.281	4.45	19.98	58	
		$\bar{x}$	4.9	.322	4.38	21.18	54.0	
		$\bar{x}$ 12	4.97	.369	4.37	17.54	49.3	
		$\bar{x}$ 24	4.83	.352	4.4	25.67	50.3	
		$\bar{x}$ 48	4.87	.339	4.42	18.87	54.7	
		$\bar{\bar{x}}$	4.9	.353	4.4	20.69	51.4	

TABLE I (Continued)

Cultivar	Holding Treatment	Hold Time	% Soluble Solids	% Total Acids	pH	Vitamin C	Agtron F	Agtron E
H 14456	Water	12	4.5	.339	4.4	13.85	53	37
		24	4.6	.416	4.4	19.25	40	
		48	5.4	.454	4.4	16.65	52	
		$\bar{x}$	4.8	.403	4.4	16.58	48.3	37
	Solution	12	5.5	.429	4.4	11.08	51	40
		24	5.0	.403	4.4	19.25	48	
		48	4.9	.493	4.4	14.98	64	
		$\bar{x}$	5.1	.442	4.4	15.01	54.3	40
	Dry	12	4.8	.416	4.4	13.85	42	39.6
		24	5.6	.429	4.4	19.25	46	
		48	5.4	.384	4.4	13.32	55	
		$\bar{x}$	5.3	.410	4.4	15.47	47.7	39.6
		$\bar{x}$ 12	4.9	.395	4.4	12.93	48.7	38.9
		$\bar{x}$ 24	5.06	.416	4.4	19.25	44.7	
		$\bar{x}$ 48	5.2	.444	4.4	14.98	57.0	
		$\bar{x}$	5.05	.418	4.4	15.72	50.13	

TABLE I (Continued)

Cultivar	Holding Treatment	Hold Time	% Soluble Solids	% Total Acids	pH	Vitamin C	Agtron F	Agtron E
Bouncer	Water	12	4.2	.307	4.45	13.85	53	54.35
		24	4.2	.269	4.55	17.32	44	49.35
		48	3.6	.282	4.6	16.65	51	
		$\bar{x}$	4.0	.286	4.53	15.94	49.3	51.85
	Solution	12	4.0	.301	4.4	13.85	44	49.94
		24	4.8	.397	4.5	19.25	46	47.25
		48	4.2	.243	4.5	14.98	49	
		$\bar{x}$	4.3	.314	4.47	16.03	46.3	48.59
	Dry	12	5.0	.275	4.45	15.24	53	45.21
		24	5.0	.282	4.5	23.10	47	43.75
		48	4.6	.256	4.4	16.65	59	
		$\bar{x}$	4.9	.271	4.48	18.33	53.0	44.30
		$\bar{x}$ 12	4.4	.294	4.43	14.31	50	49.8
		$\bar{x}$ 24	4.7	.316	4.52	19.89	45.7	46.8
		$\bar{x}$ 48	4.13	.260	4.5	16.09	53	
		$\bar{\bar{x}}$	4.4	.290	4.48	16.77	49.6	48.30

TABLE I (Continued)

Cultivar	Holding Treatment	Hold Time	% Soluble Solids	% Total Acids	pH	Vitamin C	Agtron F	Agtron E
LaBonita	Water	12	4.8	.397	4.3	16.62	56	
		24	4.8	.397	4.4	23.10	55	
		48	5.0	.371	4.4	16.65	53	
		$\bar{x}$	4.9	.388	4.37	18.79	54.7	
	Solution	12	4.6	.422	4.3	16.62	50	
		24	5.2	.448	4.4	23.10	57	
		48	4.9	.390	4.3	16.65	62	
		$\bar{x}$	4.9	.428	4.37	18.79	56.3	
	Dry	12	5.0	.384	4.4	18.00	63	
		24	4.4	.333	4.4	26.95	50	
		48	4.9	.326	4.4	16.65	67	
		$\bar{x}$	4.8	.348	4.4	20.53	60.0	
		$\bar{x}$ 12	4.8	.301	4.33	17.08	56.3	
		$\bar{x}$ 24	4.8	.393	4.4	24.38	54	
		$\bar{x}$ 48	4.93	.362	4.37	16.65	60.7	
		$\bar{x}$	4.84	.385	4.37	19.37	57	

TABLE I (Continued

Cultivar	Holding Treatment	Hold Time		% Soluble Solids	% Total Acids	pH	Vitamin C	Agtron F	Agtron E
68624	Water		12	5.2	.448	4.5	16.62	44	36.9
			24	4.9	.480	4.4	17.32	45	38.37
			48	5.4	.467	4.3	13.32	52	
		$\bar{x}$		5.2	.465	4.4	15.75	47.0	37.64
	Solution		12	5.4	.403	4.3	16.62	44	
			24	4.6	.442	4.4	23.10	40	40.4
			48	4.6	.416	4.4	16.65	55	
		$\bar{x}$		4.9	.420	4.37	18.79	46.3	40.4
	Dry		12	5.2	.390	4.3	16.62	51	
			24	5.5	.493	4.3	19.25	52	
			48	4.8	.410	4.4	14.98	52	
		$\bar{x}$		5.2	.431	4.37	16.95	51.7	
		$\bar{x}$	12	5.3	.414	4.37	16.62	46.3	
		$\bar{x}$	24	5.0	.472	4.37	19.89	45.7	
		$\bar{x}$	48	4.9	.431	4.37	14.98	53	
		$\bar{\bar{x}}$		5.1	.439	4.37	17.16	48.3	38.62

TABLE I (Continued)

Cultivar	Holding Treatment	Hold Time	% Soluble Solids	% Total Acid	pH	Vitamin C	Agtron F	Agtron E
Chico Grande	Dry	12	5.0	.320	4.5	13.02	33	
		24	4.7	.333	4.6	10.85	31	
		48	4.6	.269	4.6	11.90	30	
		$\bar{x}$	4.8	.307	4.59	11.92	31.3	
	Solution	12	5.0	.346	4.6	13.02	31	
		24	5.2	.371	4.5	10.85	29	
		48	4.4	.333	4.65	9.52	31	
		$\bar{x}$	4.9	.350	4.58	11.13	30.3	
		$\bar{x}$ 12	5.0	.333	4.55	13.02	32	
		$\bar{x}$ 24	4.95	.352	4.55	10.85	30	
		$\bar{x}$ 48	4.5	.301	4.62	10.71	30.5	
		$\bar{\bar{x}}$	4.8	.329	4.57	11.53	30.8	
Harvester	Dry	12	4.2	.269	4.55	10.85	36	
		24	5.0	.262	4.6	13.02	33	
		48	5.0	.256	4.6	16.66	30	
		$\bar{x}$	4.7	.264	4.55	13.51	33.0	
	Solution	12	4.6	.294	4.5	10.85	30	
		24	4.0	.320	4.5	8.68	36	
		48	4.3	.288	4.55	11.90	30	
		$\bar{x}$	4.3	.301	4.52	10.48	32.0	
		$\bar{x}$ 12	4.4	.282	4.52	10.85	33	
		$\bar{x}$ 24	4.5	.291	4.55	10.85	34.5	
		$\bar{x}$ 48	4.65	.272	4.57	14.28	30	
		$\bar{\bar{x}}$	4.5	.282	4.55	11.99	32.5	

TABLE I (Continued)

Cultivar	Holding Treatment	Hold Time	% Soluble Solids	% Total Acids	pH	Vitamin C	Agtron F	Agtron E
Heinz 14451	Dry	12	5.4	.314	4.5	11.93	35	
		24	4.9	.326	4.6	13.02	32	
		48	5.5	.358	4.5	14.28	31	
		$\bar{x}$	5.3	.333	4.53	13.08	32.7	
	Solution	12	5.4	.371	4.4	13.02	44	
		24	5.2	.358	4.4	10.85	44	
		48	5.3	.371	4.5	11.90	46	
		$\bar{x}$	5.3	.367	4.43	11.92	44.7	
		$\bar{x}$ 12	5.4	.343	4.45	12.48	39.5	
		$\bar{x}$ 24	5.05	.342	4.5	11.93	38	
		$\bar{x}$ 48	5.4	.365	4.5	13.09	38.5	
		$\bar{\bar{x}}$	5.3	.350	4.48	12.5	38.7	

TABLE II. 1968 TOMATO CULTIVAR EVALUATION GRADE AND OBJECTIVE EVALUATION OF WHOLE TOMATOES

Cultivars	Hdlg.	Hold Time	pH	% Total Acid	Drained Weight	Whole-ness	Color	Abs. of Defects	Total Score	Grade
XP 627	Water	12	4.5	.390	15.6	17.0	25.6	27.0	85.2	B
		24	4.6	.384	15.2	17.0	28.0	26.0	86.6	B
		48	4.4	.416	17.3	16.0	25.6	26.0	84.9	B
		$\bar{x}$	4.5	.397	16.0	16.6	26.4	26.3	85.3	B
	Dry	12	4.3	.358	16.0	17.6	26.3	27.0	86.9	B
		24	4.5	.384	15.6	19.6	27.0	27.0	89.2	B
		48	4.4	.410	18.3	16.6	25.6	27.0	87.5	B
		$\bar{x}$	4.4	.384	16.6	17.9	26.3	27.0	87.8	B
	Solution	12	4.3	.429	15.0	17.0	26.3	27.0	85.3	B
		24	4.3	.429	15.6	17.3	25.6	27.0	85.5	B
		48	4.35	.416	16.6	16.0	25.0	27.0	84.6	B
		$\bar{x}$	4.30	.425	15.7	16.8	25.6	27.0	85.1	B
		$\bar{x}$ 12	4.36	.392	15.5	17.2	26.1	27.0	85.8	B
		$\bar{x}$ 24	4.46	.400	15.5	18.0	26.9	26.7	87.1	B
		$\bar{x}$ 48	4.38	.414	17.4	16.2	25.4	26.7	85.7	B
		$\bar{x}$	4.4	.402	16.1	17.1	26.1	26.8	86.1	B

TABLE II (Continued)

Cultivars	Hdlg.	Hold Time	pH	% Total Acid	Drained Weight	Whole-ness	Color	Abs. of Defects	Total Score	Grade
H 14456	Water	12	4.4	.429	16.6	17.3	25.6	27.0	86.5	B
		24	4.3	.474	16.0	15.6*	25.3	26.0	82.9	C
		48	4.3	.486	18.0	15.6*	24.6	24.3	82.5	C
		$\bar{x}$	4.3	.463	16.9	16.2	25.2	25.8	83.9	B
	Dry	12	4.5	.371	16.6	17.6	26.3	27.0	87.5	B
		24	4.6	.397	16.3	19.3	26.6	27.0	89.2	B
		48	4.3	.422	18.0	17.3	26.0	25.6	86.9	B
		$\bar{x}$	4.4	.397	17.0	18.1	26.3	26.5	87.9	B
	Solution	12	4.5	.448	17.6	19.0	24.6	24.0	85.2	B
		24	4.3	.493	16.3	16.6	23.6*	24.0	80.5	C
		48	4.4	.454	16.0	17.6	25.6	25.0	84.2	B
		$\bar{x}$	4.4	.465	16.6	17.7	24.6	24.3	83.2	B
		$\bar{x}$ 12	4.47	.416	16.9	18.0	25.5	26.0	86.4	B
		$\bar{x}$ 24	4.40	.455	16.2	17.2	25.2	25.7	84.3	B
		$\bar{x}$ 48	4.33	.454	17.3	16.8	25.2	25.0	84.3	B
		$\bar{\bar{x}}$	4.4	.442	16.8	17.3	25.3	25.5	84.9	B

*limiting rule

TABLE II (Continued)

Cultivars	Hdlg.	Hold Time	pH	% Total Acid	Drained Weight	Whole-ness	Color	Abs. of Defects	Total Score	Grade
Bouncer	Water	12	4.5	.326	17.0	19.6	24.6*	30.0	91.2	B
		24	4.5	.333	16.0	19.6	27.0	28.6	91.2	A
		48	4.5	.288	16.3	20.0	24.3*	30.0	90.6	B
		$\bar{x}$	4.5	.316	16.4	19.7	25.3*	29.5	90.9	B
	Dry	12	4.55	.320	17.6	18.6	24.0	28.3	87.5	B
		24	4.6	.301	17.0	20.0	27.0	30.0	94.0	A
		48	4.5	.288	18.6	20.0	26.3*	30.0	94.9	B
		$\bar{x}$	4.55	.303	17.7	19.5	25.8*	29.4	92.4	B
	Solution	12	4.5	.339	17.3	18.6	25.0	29.0	89.9	B
		24	4.5	.301	18.0	20.0	24.3*	30.0	92.3	B
		48	4.55	.307	18.0	19.6	24.0*	30.0	91.6	B
		$\bar{x}$	4.5	.316	17.8	19.4	24.4*	29.7	91.3	B
		$\bar{x}$ 12	4.51	.328	17.3	18.9	24.5	29.1	89.8	B
		$\bar{x}$ 24	4.53	.311	17.0	19.9	26.1	29.5	92.5	B
		$\bar{x}$ 48	4.51	.294	17.6	19.9	24.9	30.0	92.4	B
		$\bar{x}$	4.5	.312	17.3	19.5	25.2*	29.5	91.5	B

* limiting rule

TABLE II (Continued)

Cultivars	Hdlg.	Hold Time	pH	% Total Acid	Drained Weight	Whole-ness	Color	Abs. of Defects	Total Score	Grade
LaBonita	Water	12	4.4	.454	16.3	18.6	26.6	25.0	86.5	B
		24	4.3	.448	16.0	16.0	26.0	27.0	85.0	B
		48	4.4	.429	16.6	15.6*	25.6	26.0	83.8	C
		$\bar{x}$	4.4	.444	16.3	16.7	26.1	26.0	85.1	B
	Dry	12	4.4	.403	16.0	18.6	27.6	27.3	89.5	B
		24	4.3	.429	16.0	18.0	26.0	27.0	87.0	B
		48	4.4	.403	18.0	15.6*	26.0	26.6	86.2	C
		$\bar{x}$	4.4	.412	16.7	17.4	26.5	27.0	87.6	B
	Solution	12	4.4	.442	16.0	18.6	27.3	27.0	88.9	B
		24	4.3	.461	15.6	15.3*	25.6	27.0	83.5	C
		48	4.4	.448	16.6	15.3*	26.0	27.0	84.9	C
		$\bar{x}$	4.4	.451	16.1	16.4	26.3	27.0	85.8	B
		$\bar{x}$ 12	4.4	.433	16.1	18.6	27.2	26.4	88.3	B
		$\bar{x}$ 24	4.3	.446	15.9	16.4	25.9	27.0	85.2	B
		$\bar{x}$ 48	4.4	.426	17.1	15.5	25.9	26.5	85.0	B
		$\bar{\bar{x}}$	4.4	.436	16.4	16.8	26.3	26.7	86.2	B

* limiting rule

TABLE II (Continued)

Cultivars	Hdlg.	Hold Time	pH	% Total Acid	Drained Weight	Whole-ness	Color	Abs. of Defects	Total Score	Grade
68624	Water	12	4.3	.531	15.6	15.0*	26.0	30.0	86.6	C
		24	4.3	.429	14.3	15.3*	26.3	27.3	83.2	C
		48	4.4	.480	16.0	15.3*	24.6	30.0	85.9	C
		$\bar{x}$	4.3	.480	15.3	15.2*	25.6	29.1	85.2	C
	Dry	12	4.4	.422	15.6	18.3	26.6	28.6	89.1	B
		24	4.4	.454	16.0	15.6*	28.6	26.6	86.1	C
		48	4.4	.416	17.3	17.0	26.6	28.6	89.5	B
		$\bar{x}$	4.4	.431	16.3	17.0	27.3	27.9	88.5	B
	Solution	12	4.4	.480	15.3	16.0	24.6	28.0	83.9	B
		24	4.4	.442	14.6	17.0	26.0	28.6	86.2	B
		48	4.4	.448	15.3	15.3*	24.3	30.0	85.9	C
		$\bar{x}$	4.4	.457	15.1	16.1	25.0	28.9	85.1	B
		$\bar{x}$ 12	4.36	.478	15.5	16.4	25.7	28.9	86.7	B
		$\bar{x}$ 24	4.36	.442	15.0	16.0	27.0	27.5	85.5	B
		$\bar{x}$ 48	4.40	.448	16.2	15.9	25.2	29.5	86.8	B

* limiting rule

TABLE II (Continued)

Cultivars	Hdlg.	Hold Time	pH	% Total Acid	Drained Weight	Whole-ness	Color	Abs. of Defects	Total Score	Grade
Chico Grande	Dry	12	4.4	.416	16.3	20.0	28.3	30.0	94.6	A
		24	4.5	.390	17.0	17.6	27.6	30.0	91.2	A
		48	4.5	.416	18.0	20.0	26.6*	28.0	92.6	B
		$\bar{x}$	4.5	.407	17.1	19.2	27.5	29.3	93.1	A
	Solution	12	4.5	.352	16.3	17.0	27.0	28.0	88.3	B
		24	4.6	.416	16.0	18.0	27.0	27.6	88.6	B
		48	4.4	.358	15.3	16.0	27.6	28.0	86.9	B
		$\bar{x}$	4.5	.375	15.9	17.0	27.2	27.9	88.0	B
		$\bar{x}$ 12	4.45	.384	16.3	18.5	27.7	29.0	91.5	A
		$\bar{x}$ 24	4.55	.403	16.5	17.8	27.3	28.8	90.4	A
		$\bar{x}$ 48	4.45	.387	16.7	18.0	27.1	28.0	89.8	B
		$\bar{\bar{x}}$	4.5	.391	16.5	18.1	27.4	28.6	90.6	A
Harvester	Dry	12	4.5	.320	16.3	19.0	27.6	29.0	91.9	A
		24	4.5	.333	17.3	19.0	27.6	29.0	92.9	A
		48	4.5	.314	18.6	19.0	26.0*	30.0	93.6	B
		$\bar{x}$	4.5	.323	17.4	19.0	27.1	29.3	92.8	A
	Solution	12	4.6	.339	16.6	19.6	28.3	28.6	93.1	A
		24	4.5	.384	18.0	19.0	28.0	29.0	94.0	A
		48	4.6	.346	18.6	19.0	29.6	29.0	96.2	A
		$\bar{x}$	4.56	.358	17.7	19.2	28.6	28.8	94.3	A
		$\bar{x}$ 12	4.55	.330	16.5	19.3	28.0	28.8	92.6	A
		$\bar{x}$ 24	4.5	.359	17.4	19.0	27.8	29.0	93.2	A
		$\bar{x}$ 48	4.55	.330	18.6	19.0	27.8	29.5	94.9	A
		$\bar{\bar{x}}$	4.53	.341	17.6	19.1	27.9	29.1	93.7	A

TABLE II (Continued)

Cultivars	Hdlg.	Hold Time	pH	% Total Acid	Drained Weight	Whole-ness	Color	Abs. of Defects	Total Score	Grade
Heinz 14451	Dry	12	4.5	.339	18.0	20.0	29.3	30.0	97.3	A
		24	4.5	.339	17.3	20.0	29.0	30.0	96.3	A
		48	4.4	.422	18.3	19.0	27.6	28.0	92.9	A
		$\bar{x}$	4.46	.300	17.8	19.7	28.6	29.3	95.6	A
	Solution	12	4.5	.352	16.3	19.3	25.6*	30.0	91.2	B
		24	4.5	.333	18.0	20.0	27.0	29.0	94.0	A
		48	4.4	.384	17.6	17.6	26.3	28.3	89.8	B
		$\bar{x}$	4.46	.356	17.3	19.0	26.3	29.1	91.7	A
		$\bar{x}$ 12	4.5	.346	17.2	19.7	27.5	30.0	94.4	A
		$\bar{x}$ 24	4.5	.327	17.4	20.0	28.0	29.5	94.9	A
		$\bar{x}$ 48	4.4	.403	17.9	18.3	27.0	28.2	91.4	A
		$\bar{\bar{x}}$	4.46	.328	17.6	19.4	27.5	29.2	93.7	A

* limiting rule

THE EFFECTS OF LYE PEELING VARIABLES UPON TOMATO CULTIVARS

by

Loren Lucas and W. A. Gould

During 1968, eight tomato cultivars were evaluated with respect to their adaptability for the lye peeling process. The tomatoes were grown at Hoytville, Ohio. After harvesting, they were shipped to Columbus for processing.

Following the washing, tomatoes were peeled by the following methods (none of the tomatoes were cored):

a) The check lot of tomatoes was steam peeled by exposure to live steam for 45 seconds followed by removal of peel by hand.

b) A second group of tomatoes (9 lots for each cultivar at each harvest) was submerged in selected concentrations (16, 18, and 20 %) of caustic soda at temperatures of 190, 200 and 210°F. The time required for complete peel removal by a circulating cold (65 to 70°F.) water rinse was determined for each variety under each of the conditions of lye concentration and temperature.

c) A third group of tomatoes (9 lots for each cultivar at each harvest) was peeled with caustic soda in the same manner with the exception that the wetting agent, Faspeel, was added at a rate of 0.3% by volume.

d) A fourth group of tomatoes (9 lots for each cultivar at each harvest) peeled with caustic soda, in the same manner, with the addition of 0.3% Tergitol by volume.

When the peeling operation was complete, 303 cans were filled with 10.5 to 11 ounces of tomato samples, covered with 180°F. tomato juice and a 30 grain salt (21 gr. NaCl and 9 gr. $CaCl_2$) tablet was added. After filling, the cans were steam flow closed (17 psi) with the aid of a 006 American Can Company closing machine and processed in a non-agitating retort for 20 minutes at 220°F. All cans were then cooled to 100°F. Following a storage period of 4 months at room temperature, the tomatoes were graded according to the U.S.D.A. Standards for Grades of Canned Tomatoes. The pH and total acid (calculated as citric acid) were determined for each sample. The average values for each cultivar, under the various peeling operations are given in the following tables.

RESULTS

The tomato cultivar most rapidly lye peeled was the Harvester cultivar. The peeling time required was reduced as the temperature and lye concentration were increased. The Harvester cultivar also demonstrated the lowest peel loss of the cultivars evaluated. It was found that as the lye solution temperature was increased the percent peel loss was increased. The pH of the canned Harvester tomatoes was unaffected. However, the total acid content was reduced with high (20%) lye concentration. Higher drained weights were obtained when the wetting agents Faspeel and Tergitol were used. The wholeness of the canned Harvester tomatoes was unaffected by lye peeling treatments.

The Chico Grande cultivar was peeled best in an 18% lye solution. Decreased solution temperature decreased the time requirements. There was a decrease in the total acid content of canned Chico Grande tomatoes with the lye peeling process.

The wetting agents, Faspeel and Tergital, increased the efficiency of the peeling operation at 18% lye concentration for the cultivar Exp. 68624. Wholeness was improved by all lye peeling methods over steam peeling for the canned Exp. 68624 tomatoes.

Both wetting agents increased lye peeling efficiency for 18 and 20% lye solution for the cultivar Exp. 627. Temperature increases also increased peeling efficiency. There was a general total acid reduction for the lye peeled Exp. 627 tomatoes.

The time required to lye peel the cultivar H-14451 was reduced by the presence of wetting agents. This cultivar also suffered an increased peel loss as the lye solution temperature was increased. There was a reduction in total acid content of the canned tomatoes.

Wetting agents also increased the peeling efficiency for the 18% lye solution with the cultivar H-14456. Higher lye solution temperature increased the amount of peel loss. Also, the drained weight of the canned tomatoes was reduced.

The eighteen percent lye solution was the most efficient lye peeling solution for the LaBonita cultivar. There was a slight increase in pH and an overall reduction in total acid for lye peeled, canned tomatoes of this cultivar.

Increasing the lye solution concentration decreased submergance time required for the complete peel removal of the Bouncer cultivar. The peeling time was also reduced by increasing the temperature. The lye peeling operation produced a general reduction in total acid of the canned tomatoes. The drained weight of canned Bouncer tomatoes was slightly reduced by increasing the lye solution temperature.

CONCLUSION

In general, when comparing all methods under study to the conventional steam peeling method, the peeling of tomatoes by the submergence in lye solution followed by a cold water rinse increased the percent peel loss.

The high percent peel loss was due, in-part, to the method of rinsing the tomatoes following lye peeling. However, we believe these high losses can be used to evaluate the different variables in lye peeling. Differences in peel loss up to 10% were found among the various treatments. The best conditions for low peel loss were: temperature 190°F., lye concentration of 20%, and the use of a wetting agent.

There was a decrease in total acid, especially at higher temperatures and high lye concentrations. Several cultivars showed an increased drained weight and wholeness grade score when lye peeling was used.

The addition of the wetting agents (Faspeel and Tergitol) were more effective at higher lye concentration in the time required for peeling.

TABLE I A RELATIONSHIP BETWEEN 16% LYE CONCENTRATION AND TEMPERATURE TO PEELING EFFICIENCY AND QUALITY

Lye	Wetting Agent	Temp.	Cultivar	Time	% Peel Loss	pH	Total Acid	Drained Weight	Whole-ness	Color	Defects	Total Score	Grade
16	0	190°F.	Harvester	2:05	19.5	4.58	.320	16	18.5	24*	27	89.5	B
16	0	190°	Chico Grande	2:45	18.6	4.55	.294	16	20	26*	29	91	B
16	0	190°	H-14451	2:45	19.9	4.55	.336	15.5	17	24*	28	84.5	B
16	0	190°	Exp 68624	2:35	23.3	4.45	.394	16	20	26.5	29	91.5	A
16	0	190°	Exp 627	2:20	17.0	4.60	.333	15.5	19	26*	29	89.5	B
16	0	190°	H-14456	2:30	19.6	4.50	.349	15.5	19.5	25*	27.5	87.5	B
16	0	190°	Bcuncer	2:25	16.2	4.70	.237	18	17	26.5	25.5*	87	B
16	0	190°	LaBonita	2:35	21.9	4.50	.314	18	19	25*	29	91	B
			$\bar{x}$	2:30	19.50	4.55	.322	16.31	18.75	25.25*	28.00	88.31	B
16	0	200°	Harvester	2:00	13.2	4.65	.288	16.5	19.5	25.5*	29.5	91	B
16	0	200°	Chico Grande	2:35	21.1	4.60	.333	18	18	24*	28	88	B
16	0	200°	H-14451	2:20	20.4	4.50	.346	17	18	26*	28	89	B
16	0	200°	Exp 68624	2:15	14.6	4.60	.333	15	17.5	26*	26.5	85	B
16	0	200°	Exp 627	2:00	21.4	4.60	.317	16	20	25*	28.5	89.5	B
16	0	200°	H-14456	2:20	19.1	4.63	.294	16.5	18.5	23.5*	27	85.5	B
16	0	200°	Bouncer	2:20	16.6	4.63	.279	18	20	25*	29	92	B
16	0	200°	LaBonita	2:05	20.3	4.60	.326	16.5	20	22**	26*	84.5	C
			$\bar{x}$	2:14	18.33	4.60	.302	16.69	18.94	24.63*	27.81	88.07	B
16	0	210°	Harvester	1:55	24.0	4.50	.304	16	20	26*	30	92	B
16	0	210°	Chico Grande	2:25	27.5	4.60	.301	16	17	22**	27	82	C
16	0	210°	H-14451	2:10	25.1	4.60	.343	16	20	24*	30	90	B
16	0	210°	Exp 68624	2:10	23.4	4.50	.311	16	17	26*	28	87	B
16	0	210°	Exp 627	1:55	19.0	4.50	.349	16	18.5	26.5	30	91	A
16	0	210°	H-14456	2:15	19.1	4.50	.314	16.5	19	24*	28	87.5	B
16	0	210°	Bouncer	2:10	17.9	4.65	.253	17	20	23**	27	87	C
16	0	210°	LaBonita	2:00	22.1	4.55	.298	16	19	25.5*	29	89.5	B
			$\bar{x}$	2:08	22.26	4.55	.309	16.19	18.81	24.63*	28.63	88.26	B

*Limiting rule - grade must not exceed B

**Limiting rule - grade must not exceed C

TABLE I A (Continued)

Lye	Wetting Agent	Temp.	Cultivar	Time	% Peel Loss	pH	Total Acid	Drained Weight	Whole-ness	Color	Defects	Total Score	Grade
16	T	190°F.	Harvester	1:50	18.9	4.70	.311	17.5	20	26*	29	92.5	B
16	T	190°	Chico Grande	2:35	17.8	4.65	.339	17.5	18.5	24*	28	88	B
16	T	190°	H-14451	2:40	21.0	4.65	.294	18	19.5	26.5	29	93	A
16	T	190°	Exp 68624	2:25	16.3	4.58	.339	16	17	25*	27.5	85.5	B
16	T	190°	Exp 627	2:15	14.6	4.65	.288	19	19	26.5	29	92.5	A
16	T	190°	H-14456	2:30	19.1	4.65	.330	18	18	24*	26*	86	B
16	T	190°	Bouncer	2:40	18.1	4.68	.350	18	19	23.5*	26*	86.5	B
16	T	190°	LaBonita	2:40	24.2	4.70	.288	16.5	18	26*	29	89.5	B
			$\bar{x}$	2:27	18.75	4.65	.304	17.44	18.63	25.19*	27.94	89.20	B
16	T	200°	Harvester	1:50	18.9	4.70	.317	17.5	20	25*	29	91.5	B
16	T	200°	Chico Grande	2:30	21.4	4.63	.304	17	18	24.5*	27	86.5	B
16	T	200°	H-14451	2:30	23.4	4.60	.314	17.5	19.5	26*	28	92	B
16	T	200°	Exp 68624	2:20	21.0	4.58	.311	16	17.5	26.5	26*	86	B
16	T	200°	Exp 627	2:10	21.5	4.58	.288	16	19	24*	29	88	B
16	T	200°	H-14456	2:25	20.3	4.60	.298	16	18	23**	26*	83	C
16	T	200°	Bouncer	2:40	23.8	4.80	.208	17	20	24*	27	88	B
16	T	200°	LaBonita	2:45	24.1	4.70	.294	16	19	25.5*	29	89.5	B
			$\bar{x}$	2:23	21.80	4.65	.292	16.63	18.88	24.83*	27.62	87.96	B
16	T	210°	Harvester	1:45	25.2	4.70	.262	17	20	25.5*	29	91.5	B
16	T	210°	Chico Grande	2:10	28.0	4.55	.323	17	17.5	24*	28	86.5	B
16	T	210°	H-14451	2:00	29.2	4.68	.262	18	19.5	26.5	28	92	A
16	T	210°	Exp 68624	1:55	29.2	4.65	.288	16	17.5	25.5*	26.5	89.5	B
16	T	210°	Exp 627	2:05	20.1	4.65	.314	19	20	27	29	95	A
16	T	210°	H-14456	2:15	13.9	4.53	.352	18.5	19	25*	26*	88.5	B
16	T	210°	Bouncer	2:05	11.9	4.68	.269	18	19.5	25.5*	28	91	B
16	T	210°	LaBonita	2:20	26.1	4.73	.288	16	19	25.5*	29	88.5	B
			$\bar{x}$	2:04	22.95	4.52	.295	17.44	19.00	25.56*	27.94	89.94	B

*Limiting rule - grade must not exceed B

**Limiting rule - grade must not exceed C

TABLE I A (Continued)

Lye	Wetting Agent	Temp.	Cultivar	Time	% Peel Loss	pH	Total Acid	Drained Weight	Whole-ness	Color	Defects	Total Score	Grade
16	F	190°F.	Harvester	2:05	23.6	4.70	.266	19	20	24*	29	92	B
16	F	190°	Chico Grande	2:25	17.9	4.65	.339	18	19	23.5*	27	87.5	B
16	F	190°	H-14451	2:45	24.3	4.63	.330	19	20	24*	29	92	B
16	F	190°	Exp 68624	2:20	22.1	4.60	.314	17.5	19	25*	28	89.5	B
16	F	190°	Exp 627	2:15	21.5	4.68	.282	18	19.5	24.5*	29	91	B
16	F	190°	H-14456	2:35	22.1	4.60	.323	16.5	19	25*	26*	86.5	B
16	F	190°	Bouncer	2:45	17.7	4.60	.259	18	18	25*	26*	87	B
16	F	190°	LaBonita	2:35	26.8	4.60	.291	16	18.5	26.5	29	90	A
			x̄	2:28	22.0	4.63	.301	17.75	19.13	24.69*	27.88	89.45	B
16	F	200°	Harvester	1:50	24.8	4.50	.269	19	20	24*	29	92	B
16	F	200°	Chico Grande	2:35	22.0	4.60	.349	17	19	23.5*	27	86.5	B
16	F	200°	H-14451	2:30	24.6	4.60	.326	17	20	26.5	28	92.5	A
16	F	200°	Exp 68624	2:20	19.8	4.65	.301	16	19	24*	26*	85	B
16	F	200°	Exp 627	2:10	19.8	4.45	.343	17.5	20	25.5*	27	90	B
16	F	200°	H-14456	2:40	21.4	4.65	.346	16	17	26.5	26*	85.5	B
16	F	200°	Bouncer	2:20	22.1	4.65	.285	18	18	24.5*	26*	86.5	B
16	F	200°	LaBonita	2:10	25.9	4.63	.352	16.5	20	26*	28	90.5	B
			x̄	2:19	22.55	4.59	.321	17.13	19.13	25.06*	27.25	88.57	B
16	F	210°	Harvester	1:45	24.2	4.60	.355	16	20	26*	28	90	B
16	F	210°	Chico Grande	2:25	24.4	4.60	.349	16	19	25*	28	88	B
16	F	210°	H-14451	2:20	22.4	4.60	.355	17.5	20	25.5*	28	91	B
16	F	210°	Exp 68624	2:15	22.6	4.60	.362	16.5	17.5	26*	26	86	B
16	F	210°	Exp 627	2:05	26.0	4.60	.381	16	19	28	29	92	A
16	F	210°	H-14456	2:30	21.0	4.45	.394	16	17.5	24*	27	84.5	B
16	F	210°	Bouncer	2:10	23.0	4.60	.301	16	19.5	24*	27	86.5	B
16	F	210°	LaBonita	1:45	42.0	4.6	.378	19	18	27.5	28	92.5	A
			x̄	2:09	25.70	4.58	.359	16.63	18.81	25.75*	27.63	88.82	B

*Limiting rule - grade must not exceed B

**Limiting rule - grade must not exceed C

TABLE I B RELATIONSHIP BETWEEN 18% LYE CONCENTRATION AND TEMPERATURE TO PEELING EFFICIENCY AND QUALITY

Lye	Wetting Agent	Temp.	Cultivar	Time	% Peel Loss	pH	Total Acid	Drained Weight	Whole-ness	Color	Defects	Total Score	Grade
18	0	190°F.	Harvester	2:00	19.3	4.50	.368	19	20	27	28	94	A
18	0	190°	Chico Grande	2:05	19.6	4.40	.384	17	18	25.5*	28	88.5	B
18	0	190°	H-14451	2:05	17.2	4.50	.400	18	19	25*	27	91	B
18	0	190°	Exp 68624	2:15	18.9	4.50	.368	16	20	26*	27	89	B
18	0	190°	Exp 627	2:15	21.9	4.40	.404	17.5	20	25*	27	89.5	B
18	0	190°	H-14456	2:30	17.6	4.50	.416	17.5	19.5	25.5*	28	90.5	B
18	0	190°	Bouncer	2:30	17.3	4.55	.352	16.5	19.5	24*	27	87	B
18	0	190°	LaBonita	2:10	19.7	4.55	.410	18	20	27	29	94	A
			$\bar{x}$	2:13	18.94	4.49	.388	17.44	19.50	25.63*	27.88	90.45	B
18	0	200°	Harvester	1:55	19.9	4.53	.365	17.5	20	27.5	30	95	A
18	0	200°	Chico Grande	2:05	22.4	4.60	.375	17	20	25.5*	29	91.5	B
18	0	200°	H-14451	2:10	21.5	4.50	.384	17	19	24*	28.5	88.5	B
18	0	200°	Exp 68624	2:15	18.8	4.50	.355	16.5	16	26*	27	85.5	B
18	0	200°	Exp 627	2:15	18	4.60	.368	17	17	26*	29	89	B
18	0	200	H-14456	2:25	19.2	4.53	.352	16	18	26*	28	88	B
18	0	200°	Bouncer	2:20	20.0	4.70	.288	16	19.5	26*	28	89.5	B
18	0	200°	LaBonita	2:15	22.0	4.60	.365	16.5	17	28	30	91.5	A
			$\bar{x}$	2:12	20.25	4.57	.357	16.69	18.31	26.12	28.69	89.81	B
18	0	210°	Harvester	1:50	16.6	4.60	.358	17	19.5	27	30	93.5	A
18	0	210°	Chico Grande	2:05	22.0	4.45	.410	16.5	18.5	24*	28	80	B
18	0	210°	H-14451	2:10	22.4	4.50	.410	18	20	26*	30	94	B
18	0	210°	Exp 68624	2:05	20.1	4.50	.387	17	16.5	25.5*	28	87	B
18	0	210°	Exp 627	2:10	24.4	4.55	.384	16.5	18.5	26.5	30	91.5	A
18	0	210°	H-14456	2:20	23.2	4.53	.429	16.5	18	25.5*	28	88	B
18	0	210°	Bouncer	2:15	22.0	4.60	.304	16	19	25*	27.5	87.5	B
18	0	210°	LaBonita	2:00	22.3	4.55	.349	16.5	17	26*	30	89.5	B
			$\bar{x}$	2:09	21.63	4.54	.378	16.75	18.38	25.69*	28.94	89.76	B

*Limiting rule - grade must not exceed B

**Limiting rule - grade must not exceed C

TABLE I B (Continued)

Lye	Wetting Agent	Temp.	Cultivar	Time	% Peel Loss	pH	Total Acid	Drained Weight	Whole-ness	Color	Defects	Total Score	Grade
18	T	190°F.	Harvester	1:45	18.1	4.60	.326	17.5	20	27	29	93.5	A
18	T	190°	Chico Grande	2:05	16.0	4.55	.339	17	19.5	23.5*	29	89	B
18	T	190°	H-14451	2:10	18.0	4.60	.375	19	20	26*	29	94.5	B
18	T	190°	Exp 68624	2:20	13.5	4.68	.330	18	17	27	27	89	B
18	T	190°	Exp 627	2:35	20.7	4.68	.288	18	20	27	29	94	A
18	T	190°	H-14456	2:35	14.8	4.58	.362	19	19	24*	27	89	B
18	T	190°	Bouncer	2:45	15.1	4.65	.629	20	18	25.5*	26	89.5	B
18	T	190°	LaBonita	2:30	20.4	4.63	.307	17	19.5	25.5*	29	91	B
			$\bar{x}$	2:20	17.07	4.62	.324	18.19	19.00	25.69*	28.22	91.19	B
18	T	200°	Harvester	1:45	19.2	4.60	.301	19	20	26.5	29	94.5	A
18	T	200°	Chico Grande	2:20	27.0	4.55	.336	17	18	25*	29	89	B
18	T	200°	H-14451	2:10	21.5	4.50	.339	17	19	26*	29	91	B
18	T	200°	Exp 68624	2:10	20.9	4.60	.352	17	16	26*	27	86	B
18	T	200°	Exp 627	2:10	26.4	4.70	.294	19	17.5	25*	29	90.5	B
18	T	200°	H-14456	2:15	20.0	4.63	.314	18.5	19	26*	28	91	B
18	T	200°	Bouncer	2:35	18.4	4.68	.266	16.5	19.5	25.5*	26*	87.5	B
18	T	200°	LaBonita	2:20	23.4	4.55	.291	17	20	26*	29	92	B
			$\bar{x}$	2:13	22.10	4.60	.317	17.63	18.62	25.63*	28.25	90.19	B
18	T	210°	Harvester	1:40	21.8	4.60	.314	17	18	25*	29	89	B
18	T	210°	Chico Grande	2:10	26.7	4.55	.330	16.5	19	26.5	29	91	A
18	T	210°	H-14451	1:55	24.1	4.63	.343	17.5	19	26*	29	91.5	B
18	T	210°	Exp 68624	1:55	21.9	4.65	.314	17.5	18	26*	27	81.5	B
18	T	210°	Exp 627	1:50	25.1	4.63	.311	17	19	27	29	91	A
18	T	210°	H-14456	1:55	22.8	4.60	.336	17	18.5	25*	27	87.5	B
18	T	210°	Bouncer	2:10	20.6	4.70	.259	17.5	20	26.5	26*	90	B
18	T	210°	LaBonita	2:05	28.1	4.70	.314	16	18	26	29	89	B
			$\bar{x}$	1:58	23.89	4.63	.315	17.00	18.69	26.00*	28.13	89.56	B

*Limiting rule - grade must not exceed B

**Limiting rule - grade must not exceed C

TABLE I B (Continued)

Lye	Wetting Agent	Temp.	Cultivar	Time	% Peel Loss	pH	Total Acid	Drained Weight	Wholeness	Color	Defects	Total Score	Grade
18	F	190°F.	Harvester	1:45	19.7	4.73	.266	20	20	27	29	96	A
18	F	190°	Chico Grande	2:10	20.1	4.78	.250	17	19	25.5*	28	89.5	B
18	F	190°	H-14451	2:15	23.5	4.65	.294	18	20	26*	29	93	B
18	F	190°	Exp 68624	2:25	15.5	4.63	.326	17.5	19	27	26*	89.5	B
18	F	190°	Exp 627	2:45	16.8	4.70	.320	17	19	27	29	92	A
18	F	190°	H-14456	2:45	16.9	4.58	.330	18	18.5	27	26*	89.5	B
18	F	190°	Bouncer	2:30	14.2	4.65	.282	17.5	19	25*	26*	87.5	B
18	F	190°	LaBonita	2:35	20.0	4.70	.311	17	19	25.5*	28.5	90	B
			$\bar{x}$	2:24	18.34	4.68	.297	17.75	19.19	26.25	27.69	90.80	A
18	F	200°	Harvester	1:40	20.8	4.70	.294	17.5	19.5	26.5	29	92.5	A
18	F	200°	Chico Grande	2:15	20.8	4.70	.314	16.5	17.5	25*	26*	85	B
18	F	200°	H-14451	2:15	22.2	4.65	.343	16.5	20	26.5	29	92	B
18	F	200°	Exp 68624	1:50	23.9	4.60	.330	17	15.5	24.5*	26*	83	B
18	F	200°	Exp 627	2:15	23.8	4.50	.375	19.5	18	26*	29	92.5	B
18	F	200°	H-14456	2:20	21.8	4.60	.381	18.5	17	24.5*	28	87.5	B
18	F	200°	Bouncer	2:40	16.4	4.55	.294	19.5	20	26.5	26*	92	B
18	F	200°	LaBonita	2:25	14.3	4.58	.320	18	20	26.5	29	93.5	A
			$\bar{x}$	2:13	20.50	4.61	.331	17.88	18.44	25.75*	27.75	89.75	B
18	F	210°	Harvester	1:45	27.6	4.68	.320	18	19.5	27	29	93.5	A
18	F	210°	Chico Grande	2:05	24.6	4.68	.269	17	18	25.5*	26*	86.5	B
18	F	210°	H-14451	2:00	23.7	4.60	.339	19	19	26*	29	93	B
18	F	210°	Exp 68624	1:45	17.8	4.60	.323	16.5	17	27	26*	86.5	B
18	F	210°	Exp 627	1:50	22.2	4.55	.323	17	18.5	26*	29	90.5	B
18	F	210°	H-14456	2:05	19.3	4.63	.330	18.6	18	26*	26*	88.5	B
18	F	210°	Bouncer	2:10	18.5	4.75	.259	18	19.5	26.5	26*	90	B
18	F	210°	LaBonita	2:00	27.9	4.63	.333	16.5	17	25*	29	87.5	B
			$\bar{x}$	1:58	22.70	4.64	.312	17.56	18.31	26.13	27.50	89.50	B

*Limiting rule - grade must not exceed B

**Limiting rule - grade must not exceed C

TABLE I C RELATIONSHIP BETWEEN 20% LYE CONCENTRATION AND TEMPERATURE TO PEELING EFFICIENCY AND QUALITY

Lye	Wetting Agent	Temp.	Cultivar	Time	% Peel Loss	pH	Total Acid	Drained Weight	Wholeness	Color	Defects	Total Score	Grade
20	0	190°F	Harvester	1:50	19.7	4.70	.288	19	20	26*	27.5	92.5	B
20	0	190°	Chico Grande	2:25	18.8	4.73	.285	18	20	26*	26*	90	B
20	0	190°	H-14451	2:25	20.5	4.63	.307	19	18.5	26*	28	91.5	B
20	0	190°	Exp 68624	2:20	20.2	4.65	.311	18	17	25*	26*	86	B
20	0	190°	Exp 627	2:15	15.6	4.60	.323	19	17	24.5*	29	89.5	B
20	0	190°	H-14456	2:10	15.6	4.65	.343	17.5	18	26*	26*	87.5	B
20	0	190°	Bouncer	2:15	15.6	4.70	.247	18	19	25.5*	26*	88.5	B
20	0	190°	LaBonita	2:15	18.9	4.63	.311	18	17.5	25.5*	29	90	B
			$\bar{x}$	2:13	18.11	4.66	.302	18.31	18.37	25.56*	27.19	89.44	B
20	0	200°	Harvester	1:35	19.0	4.70	.266	19	19.5	27	29	94.5	A
20	0	200°	Chico Grande	2:15	25.0	4.65	.294	17	17	26*	26*	86	B
20	0	200°	H-14451	2:15	18.9	4.65	.307	19.5	18.5	25*	28.5	91	B
20	0	200°	Exp 68624	2:15	16.7	4.58	.307	18	17.5	26*	26*	87.5	B
20	0	200°	Exp 627	2:20	21.3	4.68	.288	17.5	17	25.5*	29	89	B
20	0	200°	H-14456	2:20	21.4	4.60	.320	18.5	18.5	26*	26*	89	B
20	0	200°	Bouncer	2:10	14.2	4.68	.285	18.5	18.5	26.5	26*	89.5	B
20	0	200°	LaBonita	2:05	22.6	4.58	.307	18	17.5	26*	26*	87.5	B
			$\bar{x}$	2:09	19.89	4.62	.297	18.25	18.00	26.00*	27.06	89.25	B
20	0	210°	Harvester	1:35	20.9	4.65	.279	16.5	19.5	26*	29	91	B
20	0	210°	Chico Grande	2:05	23.1	4.65	.304	16.5	18	25*	27	86.5	B
20	0	210°	H-14451	2:15	20.8	4.73	.307	17	20	26*	28	91	B
20	0	210°	Exp 68624	2:05	28.0	4.63	.323	16.5	17	26*	2815	88	B
20	0	210°	Exp 627	2:00	18.2	4.60	.314	18.5	17	24.5*	29	89	B
20	0	210°	H-14456	2:10	28.7	4.55	.343	19	17	24*	28.5	88.5	B
20	0	210°	Bouncer	2:10	19.8	4.68	.262	16.5	18	26*	26*	86.5	B
20	0	210°	LaBonita	2:00	20.8	4.60	.301	16	19	27	29	91	A
			$\bar{x}$	2:02	22.54	4.63	.304	17.06	18.19	25.56*	28.13	88.94	B

*Limiting rule - grade must not exceed B
**Limiting rule - grade must not exceed C

TABLE I C (Continued)

Lye	Wetting Agent	Temp.	Cultivar	Time	% Peel Loss	pH	Total Acid	Drained Weight	Whole-ness	Color	Defects	Total Score	Grade
20	T	190°F.	Harvester	1:45	19.7	4.60	.301	19	19.5	23.5*	29	91	B
20	T	190°	Chico Grande	2:15	18.3	4.50	.285	19	19	22**	29	89	C
20	T	190°	H-14451	2:15	15.7	4.60	.314	18.5	20	24.5*	29	91	B
20	T	190°	Exp 68624	2:25	13.3	4.60	.368	17.5	18	25*	26*	86.5	B
20	T	190°	Exp 627	2:15	18.6	4.60	.294	18	19	26*	29	92	B
20	T	190°	H-14456	2:20	16.1	4.50	.333	17	17	27	27.5	88.5	B
20	T	190°	Bouncer	2:40	16.0	4.63	.227	18	18	23.5*	25*	85.5	B
20	T	190°	LaBonita	2:35	13.3	4.55	.314	17.5	19	26.5	30	93	A
			$\bar{x}$	2:19	16.4	4.57	.305	18.06	18.69	24.75*	28.19	89.69	B
20	T	200°	Harvester	1:40	22.7	4.70	.259	19	20	26.5	30	95.5	A
20	T	200°	Chico Grande	2:20	16.6	4.55	.279	17.5	20	24*	28	89.5	B
20	T	200°	H-14451	2:20	18.0	4.60	.311	17	20	25*	29	91	B
20	T	200°	Exp 68624	2:20	22.4	4.63	.333	16.5	17.5	25.5*	26*	85.5	B
20	T	200°	Exp 627	2:05	19.8	4.60	.275	17.5	19	25*	30	91.5	B
20	T	200°	H-14456	2:20	20.0	4.60	.320	16	18	24*	26*	84	B
20	T	200°	Bouncer	2:15	18.3	4.60	.275	19	20	26*	29	94	B
20	T	200°	LaBonita	2:25	19.5	4.55	.311	17.5	19	25.5*	29	91	B
			$\bar{x}$	2:13	19.7	4.60	.295	17.50	19.19	25.19*	28.38	90.25	B
20	T	210°	Harvester	1:35	24.3	4.70	.272	16	20	25.5*	29	90.5	B
20	T	210°	Chico Grande	2:10	27.5	4.60	.291	17.5	19	24*	28	88.5	B
20	T	210°	H-14451	1:55	22.7	4.60	.279	17	20	26.5	30	92.5	A
20	T	210°	Exp 68624	2:00	23.3	4.60	.317	16	18	26*	28	88	B
20	T	210°	Exp 627	1:55	25.4	4.58	.282	15	17	25*	28.5	85.5	B
20	T	210°	H-14456	2:10	24.0	4.63	.339	16	17.5	24.5*	28	86	B
20	T	210°	Bouncer	2:05	14.0	4.65	.231	17	20	24*	28	89	B
20	T	210°	LaBonita	2:15	22.0	4.60	.291	16	17.5	25.5*	30	89	B
			$\bar{x}$	2:01	22.9	4.62	.288	16.31	18.63	25.13*	28.69	88.63	B

*Limiting rule - grade must not exceed B

**Limiting rule - grade must not exceed C

TABLE I C (Continued)

Lye	Wetting Agent	Temp.	Cultivar	Time	% Peel Loss	pH	Total Acid	Drained Weight	Whole-ness	Color	Defects	Total Score	Grade
20	F	200°	Harvester	1:40	20.8	4.63	.266	19.5	20	25.5*	29	94	B
20	F	200°	Chico Grande	2:15	21.1	4.60	.266	17.5	18	24*	26*	85.5	B
20	F	200°	H-14451	2:15	13.6	4.70	.294	19.5	20	25.5*	29	94	B
20	F	200°	Exp 68624	2:25	16.6	4.73	.259	16.5	19.5	25*	26*	87	B
20	F	200°	Exp 627	2:10	23.3	4.60	.304	17.5	17	24.5	29	88	B
20	F	200°	H-14456	2:25	22.4	4.60	.375	19.5	17.5	24.5*	26*	87.5	B
20	F	200°	Bouncer	2:30	23.7	4.68	.231	17	18	25*	26.5	86.5	B
20	F	200°	LaBonita	2:15	21.1	4.63	.279	19.5	18	27	29	93.5	A
			$\bar{x}$	2:14	20.3	4.65	.284	18.31	18.50	25.13	27.56	89.48	B
20	F	210°	Harvester	1:35	20.9	4.70	.266	17	19.5	24*	29	89.5	B
20	F	210°	Chico Grande	2:15	22.2	4.63	.298	17	18.5	25*	29	89.5	B
20	F	210°	H-14451	2:00	21.5	4.58	.298	17	19.5	25*	28.5	90	B
20	F	210°	Exp 68624	2:15	18.9	4.63	.320	17	17	25*	26*	85	B
20	F	210°	Exp 627	2:00	23.3	4.60	.326	19	18	25*	29	91	B
20	F	210°	H-14456	2:20	21.3	4.58	.365	17.5	17	25*	26*	85.5	B
20	F	210°	Bouncer	2:35	20.4	4.70	.253	19	19	25*	26*	87.5	B
20	F	210°	LaBonita	2:05	27.6	4.70	.301	18.5	17.5	26*	29	91	B
			$\bar{x}$	2:08	22.0	4.64	.303	17.75	18.25	25.00*	27.81	88.63	B

*Limiting rule - grade must not exceed B

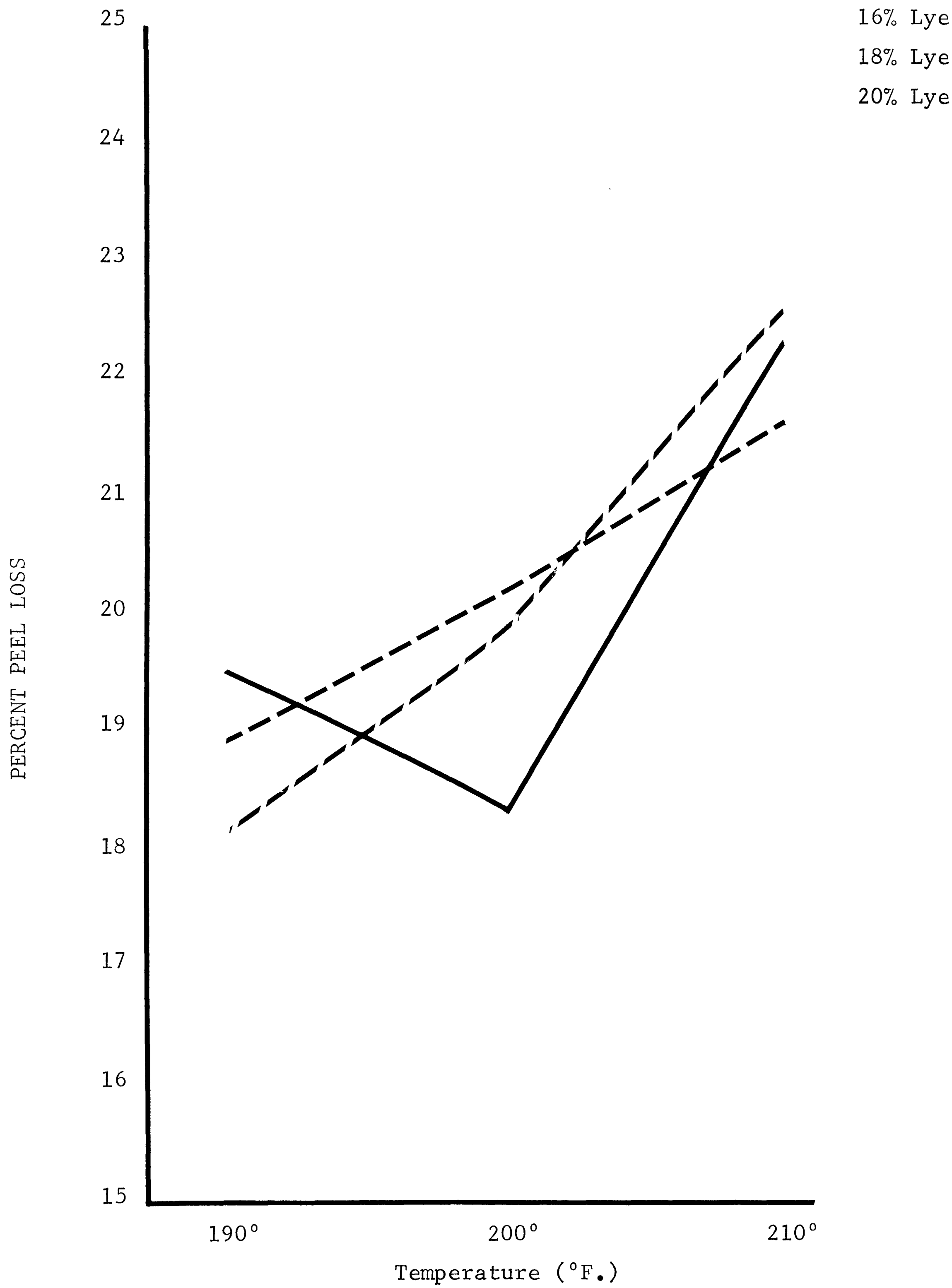
**Limiting rule - grade must not exceed C

TABLE II RELATIONSHIP BETWEEN STEAM PEELING TO PEEL LOSS AND QUALITY

Cultivar	% Peel Loss	pH	Total Acid	Drained Weight	Wholeness	Color	Defects	Total Score	Grade
Harvester	18.8	4.60	.333	18	19	27	29	93	A
Chico Grande	17.3	4.60	.288	17.5	18.5	27	28	90.5	A
H-14451	19.7	4.55	.394	18.5	19	27	29	93.5	A
Exp 68624	15.1	4.60	.371	16.5	16.5	27	28	88	B
Exp 627	15.8	4.60	.368	17	19	28	29	93	A
H-14456	14.0	4.55	.371	19.5	18	26*	28	91.5	B
Bouncer	11.5	4.65	.301	18.5	19	26.5	26*	90	B
LaBonita	19.2	4.55	.375	17	19	26*	29	91	B
$\bar{x}$	16.43	4.58	.350	17.81	18.50	26.81	28.25	91.37	A

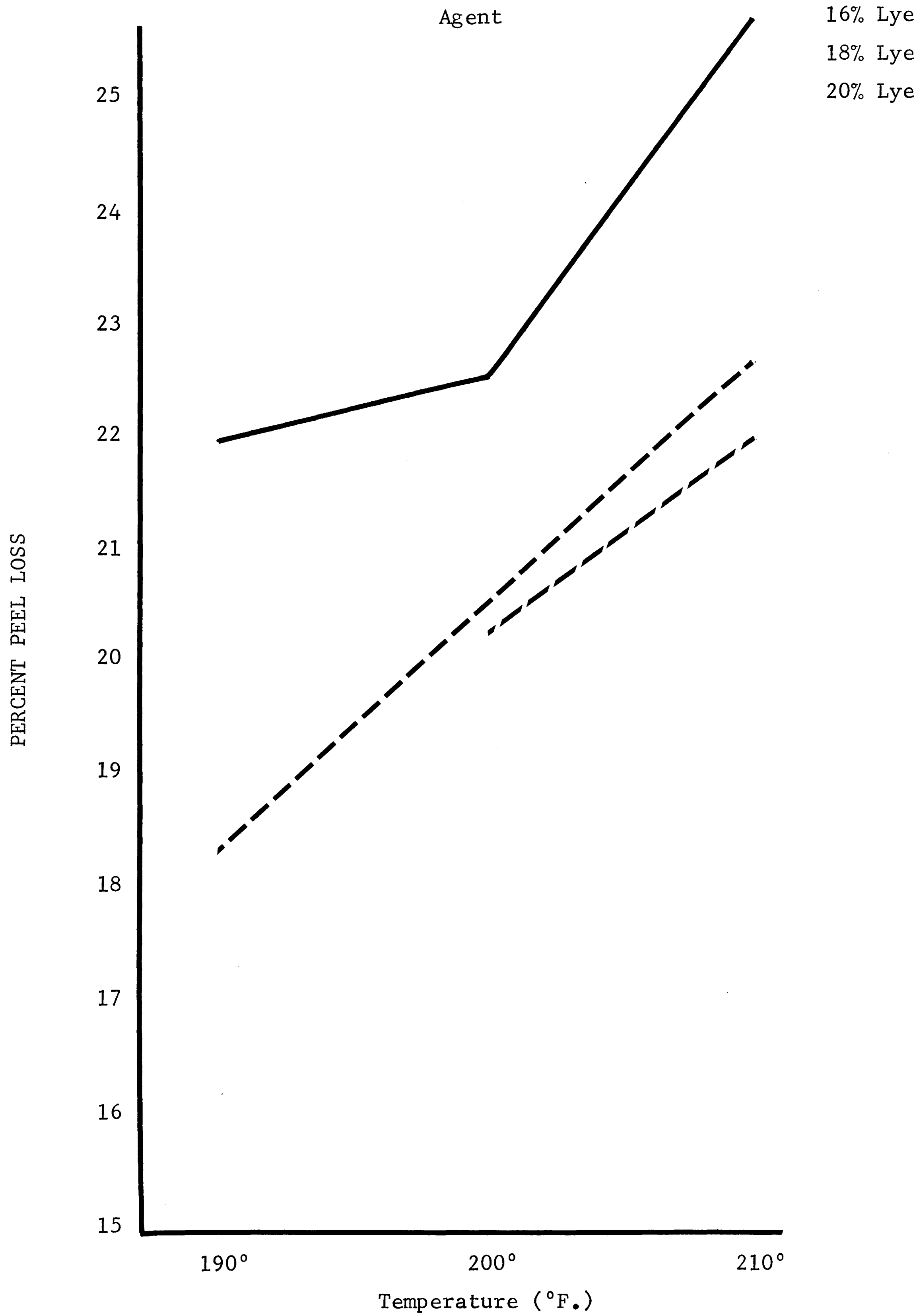
*Limiting rule - grade must not exceed B

Figure 1 - Relationship Between Temperature and Peel Loss by Concentration (16, 18 & 20%) of Lye



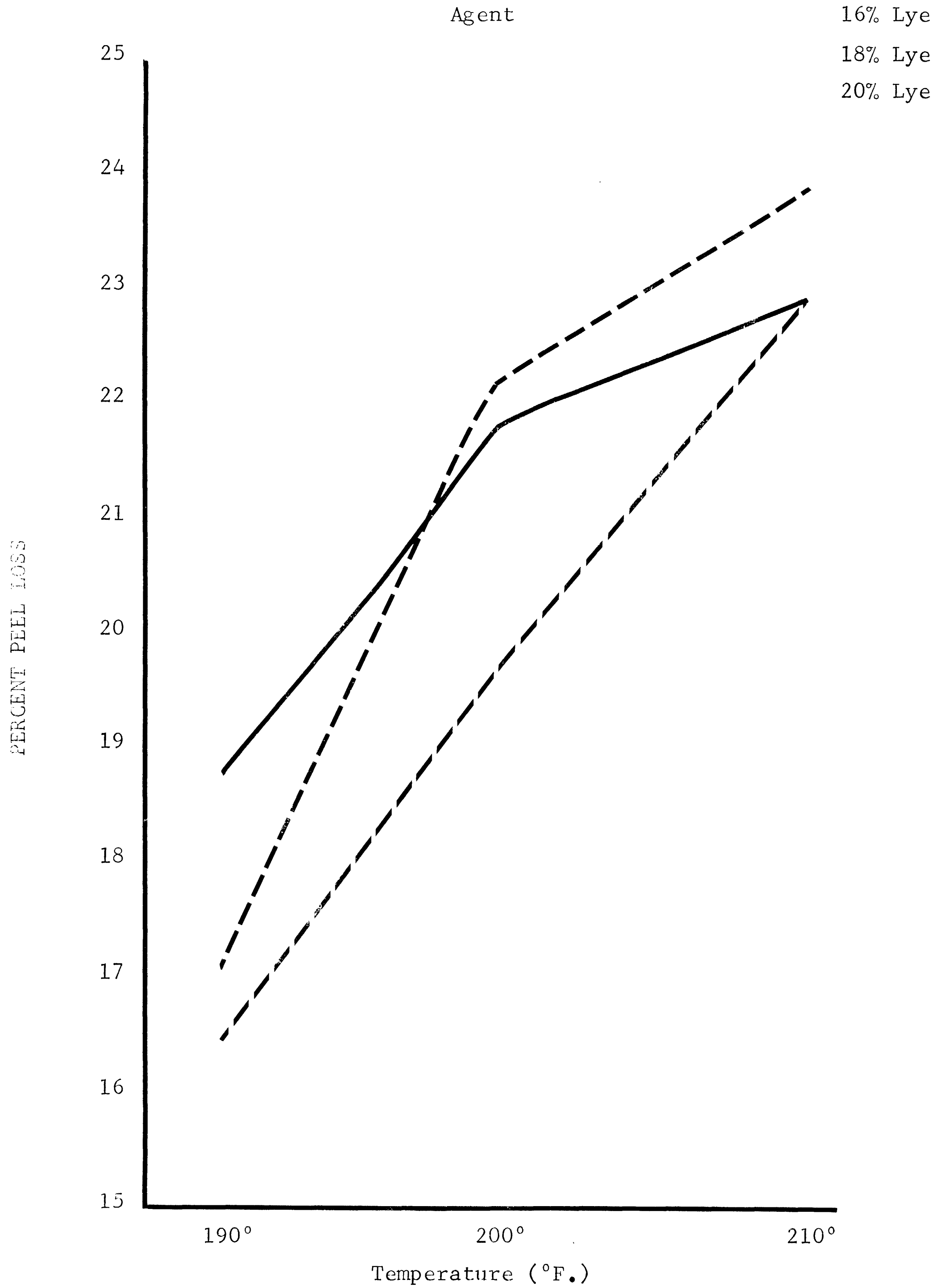
EFFECTS OF LYE CONCENTRATION ON PEEL LOSS

Figure 2 - Relationship Between Temperature and Peel Loss by Concentration (16, 18 & 20%) of Lye and Faspeel Wetting Agent



EFFECTS OF FASPEEL ON PEEL LOSS

Figure 3 - Relationship Between Temperature and Peel Loss by Concentration (16, 18 & 20%) of Lye and Tergitol Wetting Agent



EFFECTS OF TERGITOL ON PEEL LOSS

AMINO ACIDS IN CANNED TOMATO JUICE

by

Jenia D. Dormitorio and W. A. Gould

The quantitative measurements of amino acids in food products is important in relating their influence to flavor acceptance and their nutritive value for protein synthesis. The amino acids may not have a direct influence on all aspects of flavor, but their presence along with sugars, other carbohydrates, the organic acids and many other chemical constitutents may affect the flavor, color and other properties of tomato juice.

With other fruit juices the deterioration is due largely to chemical changes involving amino acids or these nitrogen compounds along with the sugars, carbohydrates and other materials. Our interest was to determine qualitatively and quantitatively the amino acids in tomato juice and then in future studies to relate these, specifically, to other changes which may or may not take place in the product.

Three tomato juice cultivars were used: Heinz 14456, SRX 8427 and Campbells 19. The samples were chromatographed and the amino acid assays were made using Technicon Amino Acid Autoanalyzer and a Technicon Integrator/Calculator.

The data are reported in the attached table by the three cultivars and the different amino acids found in the products. The three major amino acids found in all varieties were Glutamic acid, Gamma-aminobutyric and Aspartic acid in this order. These were followed by taurine, serine, alanine, and phenylalanine.

The primary results obtained in this study indicated that there was only slight qualitative difference in the amino acid contents among the cultivars used in this work. On a quantitative basis, SRX 8247 contained lower amounts of aspartic acid, glutamic acid, and phenylalanine than Heinz 14456 and Campbells 19 and a larger amount of Gamma-aminobutyric acid. Flavor studies revealed that the SRX 8427 had a lower flavor score than the other two cultivars. There may be an indirect relationship between the Gamma-aminobutyric acid and flavor acceptance.

TABLE I

DISTRIBUTION OF AMINO ACIDS IN HEINZ 14456, SRX 8427 and CAMPBELLS 19 TOMATO CULTIVARS

	HEINZ 14456			SRX 8427			CAMPBELLS 19		
Amino Acid	Free Form	Combined Form	Total	Free Form	Combined Form	Total	Free Form	Combined Form	Total
Taurine	--	5.20	5.20	--	4.6	4.6	--	--	4.9
Aspartic acid	61.3	15.9	77.2	39.3	16.8	56.1	42.8	17.3	60.1
Threonine	18.5	--	8.4	15.7	--	7.5	15.8	--	8.3
Serine	10.6	--	4.1	10.1	--	4.5	12.3	--	5.4
Glutamic acid	280.6	60.0	340.6	189.0	54.0	243.0	221.0	59.0	280.0
Proline	2.0	6.9	8.9	--	8.6	8.6	1.6	7.7	9.3
Glycine	1.3	11.1	14.4	1.4	12.9	14.3	1.9	12.0	13.9
Alanine	6.3	5.5	11.8	7.5	6.2	13.7	5.7	6.6	12.3
Valine	2.0	8.6	10.6	1.6	8.8	10.4	2.3	8.8	11.1
Cystine	--	Trace	Trace		Trace	Trace	--	Trace	Trace
Methionine	1.1	--	--	1.0	--	--	1.2	--	Trace
Unknown	--	Trace	Trace	--	Trace	Trace	--	Trace	Trace
Isoleucine	4.0	6.3	10.3	3.1	6.0	9.1	4.0	6.4	10.4
Leucine	3.4	11.4	14.8	2.3	10.9	13.2	3.9	11.8	15.7
Tyrosine	2.9	1.4	4.3	1.7	2.5	4.2	2.4	2.1	4.5
Phenylalanine	11.1	3.5	14.6	6.6	4.4	11.0	12.1	3.1	15.2
Gamma - aminobutyric	53.3	--	39.1	60.8	--	32.7	60.7	--	47.8
Ornithine	Trace	--	Trace	--	Trace	Trace	--	Trace	Trace
Lysine	5.2	8.1	13.3	3.6	8.6	12.2	4.8	9.8	14.6
Histidine	5.7	1.5	7.2	4.3	1.0	5.3	5.2	1.3	6.5
Arginine	4.4	4.1	8.5	2.0	4.8	6.8	3.4	5.3	8.7

FACTORS AFFECTING THE VISCOSITY OF TOMATO JUICE

by

David E. Crean and W. A. Gould

Research workers at the Western Regional Research Laboratory of the U.S.D.A. have established that the consistency of tomato juice can be greatly affected by adjusting the pH of broken tomatoes followed by heating, readjusting the tomato pulp to the original pH and juicing. They have found that the consistency of the final juice can be varied almost at will depending on the adjusted pH. Juices with their pH values altered to very acid values, show great thickening upon readjustment to the original pH. Juices similarly treated to a mildly alkaline pH (about 8) will gel on restoration to the original pH.

These phenomena have been explained by them in terms of enzyme action. The enzyme polygalacturonase (PG) is extremely active at the natural pH of tomatoes (about 4.4). Consequently, tomatoes broken at this pH have the enzyme in a highly active form. The enzyme breaks down the pectin and thus reduces the viscosity. By adjusting the pH to an acid value, the enzyme is rendered inactive and thus does not attack the pectin. Subsequent heating completely inactivates the enzyme.

Adjusting the pH to the alkaline side of neutrality similarly inhibits PG but, in addition, stimulates another enzyme - pectinesterase (PE). This enzyme removes methyl groups from the pectin, converting it to pectic acid. This, together with calcium ions naturally present in tomato tissue, forms a gel. Again, heating inactivates the enzymes and stabilizes the product.

In advancing this theory, the authors did not eliminate the possibility that there might be some direct action of pH on the pectins themselves as well as the cell wall solids. This investigation was designed to explore this hypothesis.

The viscosity of tomato juice is the resultant of two factors. On the one hand the viscosity of the serum fraction, which contains the soluble pectins, influences the consistency and the more pectin that can be present in this fraction, the greater will be the consistency of the juice. On the other hand the cell walls themselves contribute to the consistency of the juice. Not only is the actual number of these components important, but so is their physical size. Homogenized tomato juice has a greater consistency than unhomogenized juice. This may be explained in terms of particle size and surface area in accordance with classical concepts of viscosity.

Tomatoes were grown at the Northwestern Branch of the Ohio Agricultural Research and Development Center, Hoytville, Ohio. They were processed as juice at the pilot plant facilities of the Department of Horticulture in Columbus, Ohio.

Cell wall materials were prepared from the juice as alcohol-insoluble solids. The juice was mixed with three times its volume of 95% ethanol. Some of this was removed by decantation, the remainder being removed by filtration. The filter cake was washed with 95% ethanol; a 50:50 mixture of 95% ethanol and acetone; and finally, with acetone. The pale yellow solid was allowed to dry at room temperature and ground in a Wiley mill to pass a 40-mesh screen. The resultant powder was a pale tan in color and very light and bulky.

In a typical experiment, a weighed amount of the cell wall material (2.34 grams) was suspended in 250 ml of a suitable buffer with an ionic strength of 0.1. The suspension was allowed to equilibrate for 2-3 hours before measurement of the viscosity. The consistency of the suspension was measured using the GOSUC efflux viscometer, readings being taken in triplicate. Twenty ml of the suspension was centrifuged for 10 minutes at 2000x g and the supernatant filtered. The viscosity of this supernatant was measured in a 2 ml Ostwald viscometer.

For measurement of the pectin content of the supernatants, a 2 ml aliquot was diluted with an equal volume of 0.1N NaOH to deesterify the pectin. One ml of this solution was diluted to 25 ml. A 2 ml aliquot was pipetted into 12 ml of ice cold concentrated sulfuric acid, the contents mixed and heated for 10 minutes in a boiling water bath. The solution was allowed to cool and 1 ml of a 0.15% solution of carbazole in anhydrous methanol added. After thorough mixing, the solution was allowed to stand for 20 minutes and the color measured at 520 nm is a Beckman DU-2 spectrophotometer. Pectin contents were computed from a standard curve constructed using D-galacturonic acid monohydrate.

In a parallel series of experiments on whole tomato juice, pH adjustments were made using concentrated HCl or a 50% solution of NaOH. The pH values were measured using a Beckman Zeromatic pH meter. The viscosities of the whole juice and the serum were measured as described above. Owing to the presence of other dissolved carbohydrates in the serum, it was not found possible to measure the pectin content of these.

It was found that pH had no apparent effect on the extractability of pectin from the cell wall materials and that, in consequence, differences in consistency and viscosity could not be attributed to differences in pectin content of the solutions but rather to a direct effect on the pectic materials and the pectin-containing structures.

From the data summarized in Table I and from Figures 1 and 2, it is apparent that a consistency - pH curve for the cell wall suspensions and for the tomato juice shows two maxima - pH 3-3.5 and pH 4. If the curve is plotted for the supernatants, it is found that there is only one maximum, corresponding to the second maximum noted above. To ascertain the effects of pH on the cell wall materials, the pH - consistency curve may be replotted relative to the viscosity of the supernatants (Figure 3). This shows quite clearly that there is indeed a direct effect of pH on the cell wall materials.

Several theories may be advanced to account for this theory. Of these, the most attractive seems to be that based on the presence of ionizable groups in the cell wall. It has been shown that pH has an effect on the viscosity of pectin solutions. Since pectin is a partially esterified polymer of D-galacturonic acid, it seems likely that changes in ionization of these groups can lead to changes in viscosity. A similar argument can be advanced to explain the effect of pH on the cell wall materials. One of the fractions comprising the cell wall - an arabino-galactan - has been shown to contain glucuronic acid. Changes in the ionization of this with pH could affect the swelling of the cell wall and hence the surface area and lead to changes in consistency. The fact that this takes place at a different pH from that of pectin may be explained by considering differences in the dissociation constants of the two acids. Since glucuronic acid forms a lactone readily, it is almost certainly a stronger acid than galacturonic acid. The increase in viscosity with pH would thus manifest itself at a lower pH than would be the case with pectin which is in accordance with the observed facts.

It was hoped that this effect would be utilized commercially to improve the quality of substandard juices. Experiments with whole juices, however, show that the effect is quite reversible and can not be put to any practical use.

It can be concluded, therefore, that, while there is a direct effect of pH on the pectins and pectin-containing structures of tomato juice, this effect is reversible. The effect of pH on tomato juice viscosity noted by other workers is irreversible. This means that in the one case there is a physical change which is restored to the original condition on readjustment of pH while, in the enzymic reaction, readjustment of the pH does not restore the material to its original condition. Accordingly, the theory that this occurs by enzyme action - or its inhibitation - appears to be the correct one.

TABLE I
EFFECTS OF pH ON RELATIVE CONSISTENCY AND VISCOSITY

pH	Relative consistency of whole juice C_R	Relative viscosity of supernatant N_R	C_R/N_R
Cell wall solids			
1.00	1.182	1.039	1.138
1.80	1.191	1.032	1.154
2.40	1.228	1.036	1.185
2.70	1.233	1.034	1.192
3.40	1.223	1.038	1.178
4.00	1.222	1.060	1.164
4.60	1.252	1.075	1.165
5.00	1.255	1.079	1.163
5.30	1.254	1.079	1.162
5.85	1.259	1.082	1.164
6.25	1.257	1.081	1.163
6.80	1.250	1.078	1.160
Whole juice			
1.60	1.313	1.141	1.144
1.80	1.325	1.151	1.150
2.10	1.368	1.149	1.190
2.60	1.368	1.155	1.182
3.00	1.370	1.152	1.189
3.40	1.350	1.158	1.166
3.70	1.350	1.158	1.166
5.40	1.368	1.169	1.170
6.00	1.364	1.180	1.156
8.05	1.355	1.158	1.170

Figure 1 - Effect of pH on Relative Viscosity of Cell Wall Suspensions

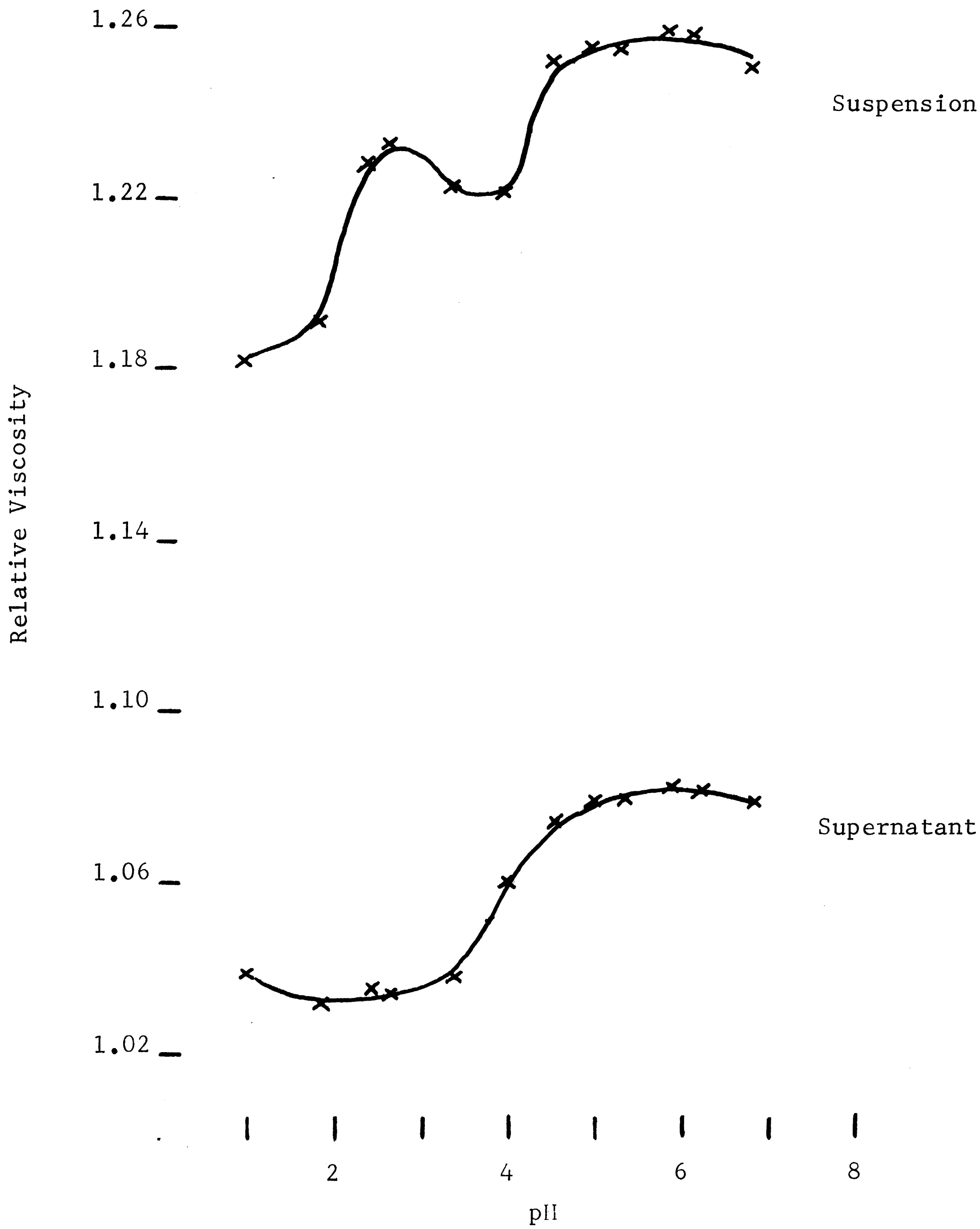


Figure 2 - Effect of pH on Relative Viscosity of Tomato Juice

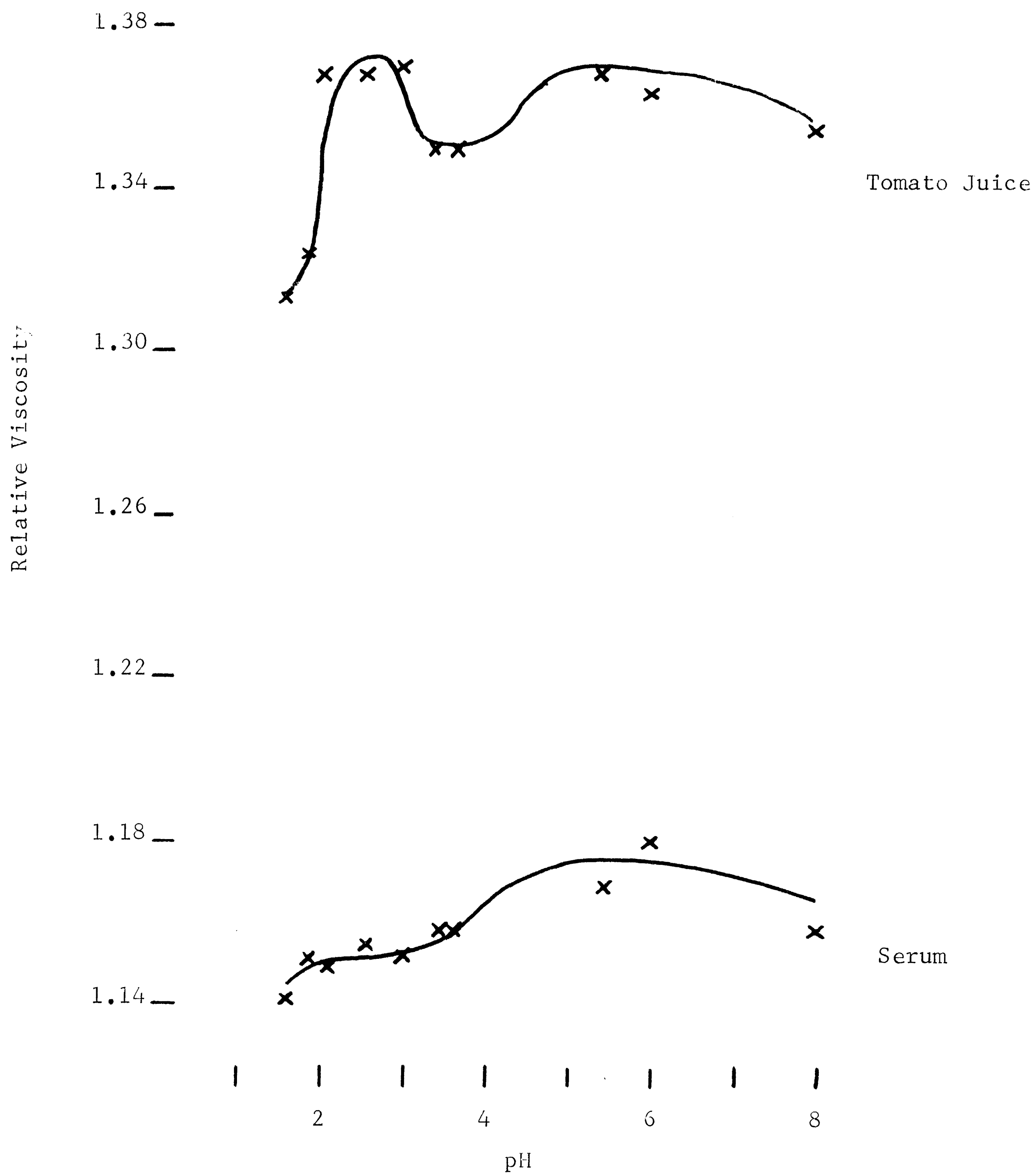
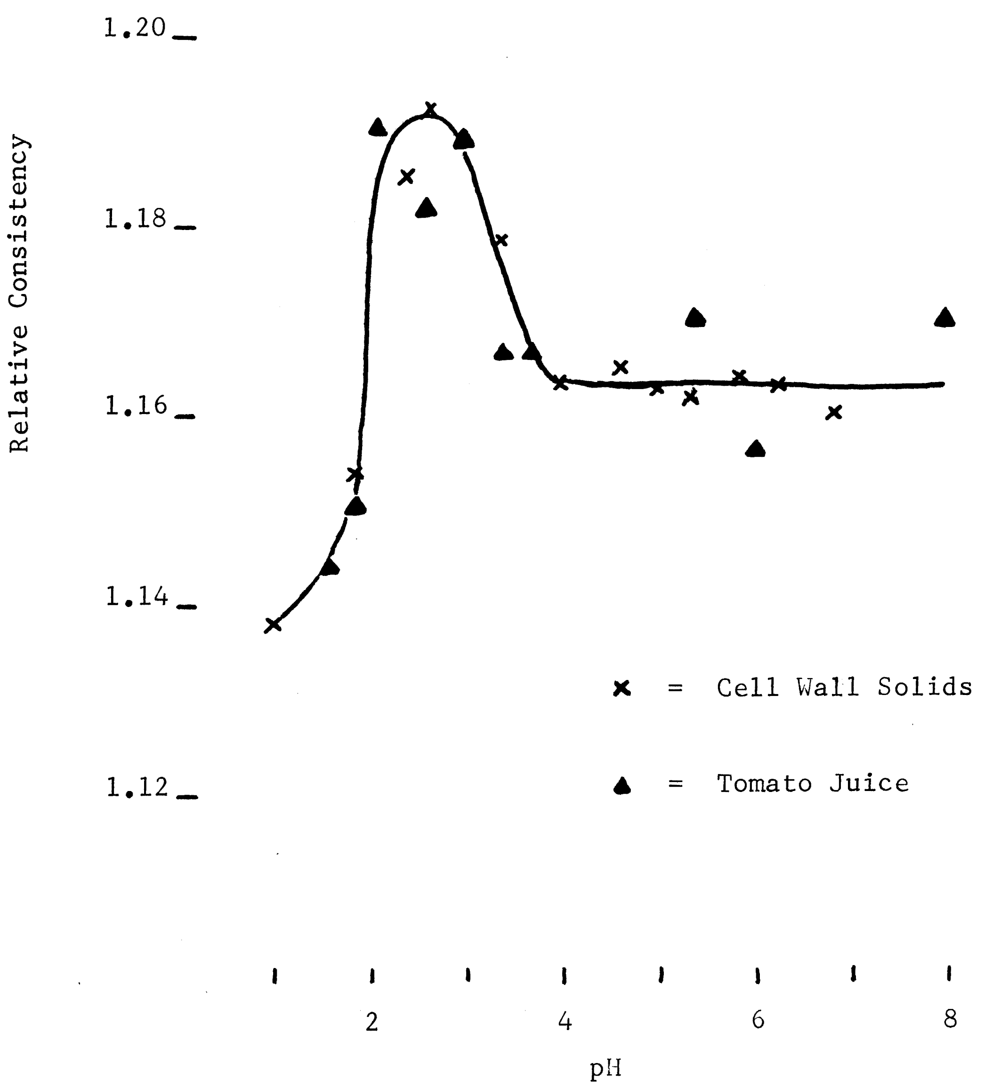


Figure 3 - Effect of pH on Consistency of Cell Walls Relative to Supernatant Viscosity



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Vegetable Crops Branch, Marietta, Washington County: 20 acres

Western Branch, South Charleston, Clark County: 428 acres