RESEARCH PROGRESS REPORTS 1962

Fruit and Vegetable Processing and Technology Division

Department of Horticulture

Ohio Agricultural Experiment Station
Wooster, Ohio

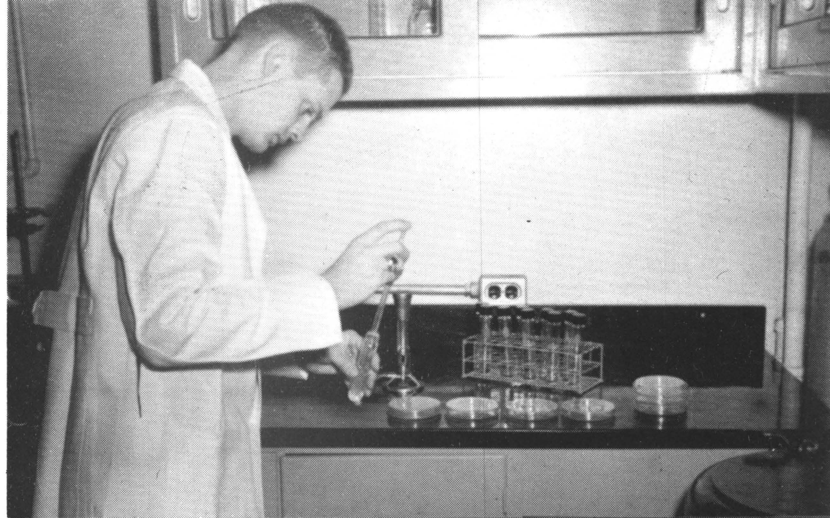
The Ohio State University

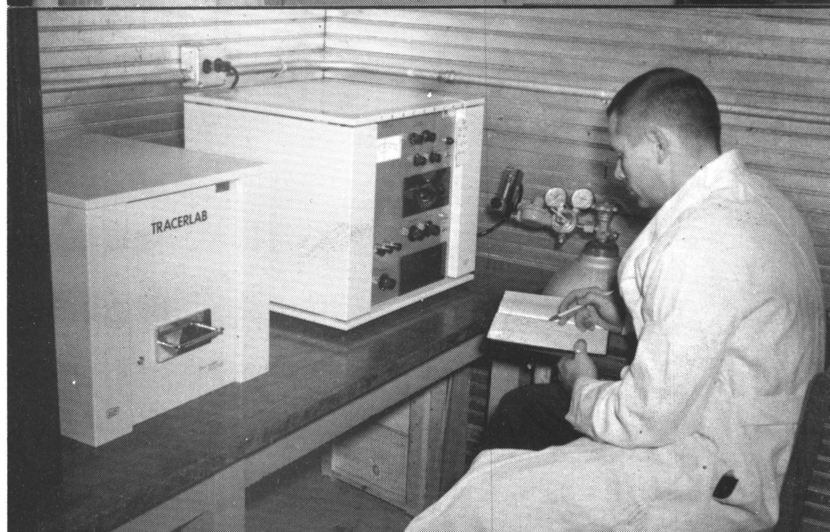
in cooperation with

The Ohio Agricultural Extension Service
1827 Neil Avenue
Columbus 10, Ohio

Department of Horticulture
Mimeograph Report No. 287

FEBRUARY, 1963





This page intentionally blank.

FRONT COVER PHOTOS

Winston D. Bash, Instructor, making bacteriological dilutions and plate counts from mechanically harvested tomatoes.

J. R. Geisman, Assistant Professor, determining the radioactivity of processed samples of food following assimilated 'Fall-Out'.

John McClelland, undergraduate student majoring in Food Technology, checking the automatic controls of the retort used for processing of vegetables.

Wade Schulte, Assistant, determining the color of tomato varieties with an Agtron E Tomato Colorimeter.

FRUIT AND VEGETABLE PROCESSING AND TECHNOLOGY DIVISION

RESEARCH PROGRESS REPORTS -- 1962

TABLE OF CONTENTS

This page intentionally blank.

TOMATO VARIETY EVALUATION FOR PROCESSING - 1962

by W. A. Gould, J. R. Geisman and Wade Schulte, Fruit and Vegetable Processing & Technology Division, Department of Horticulture, O.A.E.S.

The 1962 tomato variety trials included fifteen varieties of tomatoes which grew in replicated plots under acceptable commercial practices at the Ohio Agricultural Experiment Station Outlying Farm, Hoytville, Ohio. Each variety was harvested three or more times and following harvest, the tomatoes were hauled by truck (approximately 100 miles) to Columbus, Ohio, for processing.

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

1. Size or Average Count per 25 pounds. A random sample of twenty-five pounds of tomatoes are weighed and the total number of tomatoes are determined.
2. pH. The pH is 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. Percent Total Acid as Citric. The sample (raw or canned) used for pH determination is directly titrated using 0.1 Normal sodium hydroxide solution to a pH of 8.1. Calculations using the following equation are made:

$$\frac{\text{No. ml. of 0.1 N NaOH X .0064}}{\text{10 ml. sample}} \text{ X } 100 = \% \text{ acid as citric}$$

4. Agtron F. Samples of raw or canned tomato juice are presented to the Agtron F instrument in a standard plastic sample cup. The instrument is standardized using a black plastic plate (Monsanto Lustrex 11250) as 0 and a red plastic plate (Monsanto Lustrex 11250) as 70. Readings are taken directly.
5. Percent Soluble Solids. An Abbe 56 refractometer is used for direct determinations of percent soluble solids on raw or canned juice. The instrument is standardized with distilled water and all readings converted to 20° C.
6. Grades of Canned Tomatoes. The grade is determined in accordance with the U. S. Standards for Grades of Canned Tomatoes.

Preparation and Processing:

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

The detailed data are presented in Tables I, II, and III.

Several interesting facts are to be noted from these data: in terms of raw product quality, the smallest tomato in the trials this year was from the variety Pocomoke with the variety KC 146 having the largest size fruits. There seems to be a rather interesting trend in regards fruit size, either real small fruits or real large size fruits. Color of the tomatoes in 1962 was somewhat better than in past years and this may be attributed to the fact that they were grown in the main Ohio tomato area, that is, Hoytville, rather than at Columbus. The varieties Fireball, Heinz 1350, and VF 145 B had the lowest amount of citric acid; whereas, Rutgers had the highest amount of citric acid. This again appears to be a trend in that some of the newer varieties have lower amounts of citric acid. This may or may not have a relationship to quality and it is certainly something that the industry should concern themselves about. In terms of pH, all of the varieties this year were very low with varieties KC 135 and Delsher having an average pH of 3.97. Another interesting point concerns itself with the soluble solids and it is noted that Rutgers is considerably higher than any other variety in the trial. In terms of grade of peeled tomatoes, the better varieties in the trials were Heinz 1350, Heinz 1409, Heinz 1370, and ES 24. These four varieties were the only ones that graded out as Grade A tomatoes. Most of the others were Grade B or lower in quality due to low drained weight, or low color scores. In addition, KC 135 was scored in the Grade B category because of defects. This tomato has more core tissue than many others and in view of the trend by plant breeders on the West Coast to

This page intentionally blank.

1962

breed varieties with no core, that is a factor that the industry should concern themselves with. Rutgers, Glamour, and Delsher were scored quite low on wholeness this year. This is a trend for the Rutger variety, but samples from the variety Glamour do not normally score low on wholeness. In Table III, the scores for juice manufactured from these tomatoes indicate that all varieties are acceptable and the juice from all varieties graded as Grade A. There is considerable difference in the Agtron F color scores among the varieties with Fireball and Libby C-52 having the better color.

Table I - 1962 Raw Product Tomato Variety Evaluation - Objective Quality and Chemical Analysis

VARIETY	AVERAGE COUNT / 25 lbs.	AVERAGE AGTRON E*	% CITRIC ACID	pH	AGTRON F	% SOLUBLE SOLIDS
Fireball	137	33.6	.39	4.23	34.9	5.4
Libby C-52	128	36.6	.50	4.12	39.0	5.8
Heinz 1350	105	31.5	.42	4.18	40.0	5.53
Pocomoke	166	32.8	.46	4.10	33.7	5.06
Tecumseh	116	34.7	.45	4.18	34.3	5.73
VF 145 B	144	36.8	.39	4.16	34.6	5.6
Heinz 1409 (F)	96	42.7	.48	4.21	40.6	5.76
KC 135	76	43.6	.52	3.97	37.0	5.75
Glamour	89	41.7	.45	4.15	36.7	5.80
ES 24	94	38.9	.44	4.05	45.3	5.80
Heinz 1370	119	37.0	.45	4.17	36.3	5.73
KC 146	88	42.1	.48	4.03	48.0	5.80
Rutgers	98	39.6	.55	4.02	45.0	6.10
VF 36	96	41.2	.50	4.18	42.3	5.83
Delsher	94	42.5	.51	3.97	45.0	5.50

* Average cut surface value for 20 tomatoes.

This page intentionally blank.

Table II - 1962 Canned Tomato Variety Evaluation Data

VARIETY	pH	TOTAL ACID	U. S. GRADE FACTORS AND SCORE POINTS DR. WT. OZ.	DR. WT. SCORE	WHOLENESS	COLOR	ABSENCE OF DEFECTS	TOTAL SCORE	GRADE
Fireball	4.35	.348	10.80	17.6*	19.2	28.9	30.0	95.7	B
Libby C-52	4.20	.504	10.30	16.4*	16.4	27.8	30.0	90.6	B
Heinz 1350	4.30	.447	11.02	18.1	17.6	27.9	30.0	93.6	A
Pocomoke	4.21	.472	10.73	17.5*	15.6	26.7*	30.0	89.8	B
Tecumseh	4.28	.447	10.31	16.4*	14.9*	27.8	30.0	89.1	C
VF 145 B	4.32	.414	10.66	17.3*	16.4	28.9	30.0	92.6	B
Heinz 1409 (F)	4.28	.496	11.14	18.5	17.6	28.1	29.6	93.8	A
KC 135	4.30	.483	10.77	17.5*	16.0	29.0	25.4*	87.9	B
Glamour	4.34	.441	10.77	17.5*	14.1*	27.8	30.0	89.4	C
ES 24	4.27	.472	11.14	18.5	17.5	28.4	30.0	94.4	A
Heinz 1370	4.28	.464	11.07	18.3	16.9	28.9	30.0	94.1	A
KC 146	4.27	.506	10.88	17.9*	16.8	28.4	30.0	93.1	B
Rutgers	4.26	.533	10.31	16.4*	13.7*	27.5	30.0	87.6	C
VF 36	4.30	.454	10.52	17.0*	15.5	28.3	30.0	90.8	B
Delsher	4.39	.466	10.30	16.4*	13.6*	28.4	30.0	88.4	C

* Indicates limiting rule.

This page intentionally blank.

1962

Table III - 1962 Tomato Variety Evaluation -- Grade and Objective Evaluation of Tomato Juice

	U.S.D.A. GRADE FACTORS									
VARIETY	COLOR	CONS.	ABSENCE OF DEFECTS	FLAVOR	TOTAL SCORE	GRADE	pH	% CITRIC ACID	SOLUBLE SOLIDS	AGTRON F COLOR
Fireball	28	14	15	33	90	A	4.4	.32	6.2	34
Libby C-52	28	14	15	37	94	A	4.2	.51	6.2	36
Heinz 1350	27	14	15	33	89	A	4.22	.38	6.5	46
Pocomoke	28	14	15	36	93	A	4.15	.39	6.5	41
Tecumseh	29	14	15	38	96	A	4.21	.47	7.5	45
VF 145 B	26	14	15	33	88	A	4.26	.42	7.3	43
Heinz 1409 (F)	28	14	15	38	95	A	4.2	.48	7.0	47
KC 135	27	14	15	38	94	A	4.22	.51	7.0	41
Glamour	28	13	15	33	89	A	4.22	.41	7.6	42
ES 24	28	14	15	37	94	A	4.19	.49	7.6	48
Heinz 1370	26	14	15	37	92	A	4.2	.48	7.0	45
KC 146	28	14	15	38	95	A	4.2	.47	7.6	48
Rutgers	26	14	15	36	91	A	4.16	.55	7.7	48
VF 36	28	14	15	33	90	A	4.2	.50	7.6	45
Delsher	27	14	15	38	94	A	4.22	.51	7.6	47

This page intentionally blank.

EVALUATION OF SNAP BEAN VARIETIES FOR PROCESSING - 1962

by Wilbur A. Gould, Fruit and Vegetable Processing & Technology Division, Department of Horticulture, O.S.U.

Snap beans were grown on the Horticultural Farm at The Ohio State University. Nineteen varieties of 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 grown under acceptable commercial practices for this region. For most of the varieties, two harvests were made. Following harvest the beans were brought to the Fruit and Vegetable Processing & Technology Division Pilot Plant where they were prepared for canning and freezing. They were snipped mechanically, size graded into number three sieve and smaller and number four sieve and larger, washed, blanched in live steam for either 2 1/2 or 3 minutes depending on the sieve size, immediately cooled and packed twelve ounces into number 303 plain tin cans. Then each variety was further segregated into two lots. One lot was covered with boiling distilled water, 30 grain salt (NaCl) tablet added, sealed, and retort processed; while the second lot was sealed and frozen, without covering with water.

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

Number of plants - The actual number of plants in 200 feet were pulled and counted for each of the harvests.

Yield - The beans were weighed to determine the gross yield in pounds for the number of plants in 200 foot rows.

Number of plants per pound - The number of pods in a one pound field run sample was counted.

Percent sieve size - 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.

Pod length - Pod length was determined by evaluating 20 pods as to minimum, maximum, and average length.

Percent by weight seeds - Determined on both the canned and frozen products and reported in Tables II & III 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 both the canned and frozen products by the respective attributes of quality was determined in accordance with the U. S. Standards for Grades of Canned and the U. S. Standards for Grades of Frozen Snap Beans. The actual score points assigned each of the attributes of quality are recorded by sieve size and harvest for each of the varieties as reported in Tables II and III.

Seed Source - Seed source is indicated on the raw product data sheet (Table I) by abbreviations as follows:

A - Asgrow
Ha - Harris
Ho - Holmes
FM - Ferry Morse
B - Burpee
NK - Northrup King
R - Rogers Brothers

Lot number - The lot number of the seed follows the seed source under the variety name in Table I.

This page intentionally blank.

Table I - Snap Bean Variety Evaluation - Raw Product Data - 1962

VARIETY	HARVEST	NO. PLANTS	YIELD (lbs)	NO. /lb.	PERCENT SIEVE SIZE 1	2	3	4	5	6	LENGTH IN INCHES RANGE	AVERAGE
Bush Blue Lake A 66777	1	1688	52.0	69	1.4		2.9	7.2	26.1	62.4	3.5-4.5	3.9
Tendercrop A 86804	1	1437	74.5	140	42.9	20.0	19.3	10.0	7.1	.7	2.1-5.7	4.0
	2	1300	148.0	77	1.3	1.3	1.3	3.9	24.7	67.5	3.3-5.5	3.4
Harvester A 86645	1	1184	74.5	123	30.1	17.9	16.3	25.2	9.8	.7	1.5-5.0	4.1
	2	1200	156.0	71	2.8	1.4	8.5	8.5	16.9	61.9	3.0-6.0	4.2
NK Executive NK 109 31/131A	1	1150	114.0	70	4.3	2.9	4.3	14.3	15.7	58.5	1.8-5.4	3.5
NK Sprite NK 125	1	1335	82.5	140	22.1	32.9	38.6	6.4			1.9-5.3	3.8
	2	1372	134.0	92		2.2	12.0	34.8	42.4	8.6	2.3-5.5	4.6
VIP NK 121	1	1350	50.0	124	29.0	16.1	15.3	18.5	16.9	4.2	1.9-5.2	3.7
	2	1360	118.0	62	1.6	1.6	1.6	4.8	21.0	69.4	2.9-5.8	3.9
Abunda NK	1	964	96.0	91	14.3	8.8	13.2	18.7	23.1	21.9	1.8-5.5	3.9
	2	1000	134.0	59				5.1	6.8	88.1	2.8-5.7	4.0
Tenderwhite R 03027	1	2035	56.5	157	33.1	23.6	21.7	18.5	1.9	1.2	1.6-4.6	3.6
Imp. Hygrade R 13012	1	1775	85.5	129	31.8	13.2	16.3	15.5	17.8	5.4	1.4-5.1	3.6
	2	1734	162.0	84	7.1	8.3	7.1	6.0	33.3	38.2	1.5-5.8	3.5
Slimgreen R 13783	1	2478	146.0	125	9.6	8.0	24.8	34.4	18.4	4.8	1.9-4.8	3.3
Resist Asgrow Val. Ha 3247	1	1726	90.0	97	11.3	5.2	19.6	30.9	29.9	3.1	2.0-6.0	4.4
	2	2090	90.0	95	5.3	3.2	8.4	40.0	38.9	4.2	1.3-5.4	3.8
Contender HA 3241	1	884	106.0	75	5.3	6.7	16.0	24.0	42.7	5.3	3.4-5.9	4.7
	2	800	127.0	58				5.2	34.5	60.3	3.2-6.1	5.0
Harris Shipper HA	1	1024	90.0	90	16.7	6.7	3.3	11.1	22.2	40.0	2.5-5.6	4.0
Topmost A 46361	1	1722	137.0	70	4.3	2.9	8.6	17.1	24.3	42.8	2.0-5.7	3.5
Topcrop Ho 190	1	1644	143.0	94	9.6	4.3	4.3	10.6	23.4	47.8	2.0-5.3	3.3
Imp. Tendergreen Ha 3264	1	1307	67.0	99	6.0	9.0	10.0	37.0	28.0	10.0	2.0-5.2	3.6
FM 187C FM	1	750	68.0	79	8.9	7.6	6.3	16.5	25.3	35.4	2.1-7.4	3.8
Green Cluster FM	1	1500	61.0	157	21.7	17.2	22.3	23.6	14.0	1.2	1.5-4.8	3.2
	2	1600	89.0	69			4.3	8.7	13.0	74.0	2.5-5.8	4.0
Pearlgreen B 29751	1	1082	86.0	82	14.6	3.7	1.2	2.4	31.7	46.4	2.3-6.0	3.7
	2	1170	131.0	71	2.8	1.4	7.0	16.9	39.4	32.5	2.6-5.7	3.8

This page intentionally blank.

Table II - Snap Bean Variety Evaluation - Frozen Product Data - 1962.

VARIETY	HARVEST	SIEVE SIZE	% BY WT. OF SEEDS	U.S. GRADE: COLOR	ABS. OF DEFECTS	CHARACTER	TOTAL SCORE	GRADE
Bush Blue Lake	1	4-6	2.6	19	38	37	94	A
Tendercrop	1	1-3	3.0	19	39	38	96	A
		4-6	6.3	19	38	37	94	A
	2	1-3	6.3	19	37	36	92	A
		4-6	10.2	18	37	31*	86	C
Harvester	1	1-3	6.5	18	37	38	93	A
		4-6	7.0	18	37	35*	90	B
	2	1-3	5.3	17	34	28*	79	C
		4-6	11.5	17	35	28*	80	C
NK Executive	1	4-6	7.5	19	38	34*	91	B
NK Sprite	1	1-3	5.5	18	36	38	92	A
		4-6	11.0	17	38	33*	88	B
	2	1-3	8.1	17	38	32*	87	B
		4-6	13.0	19	38	34*	91	B
VIP	1	1-3	5.1	19	35*	39	93	B
		4-6	6.5	18	38	37	93	A
	2	1-3	7.0	17	36	35*	88	B
		4-6	18.0	18	36	34*	88	B
Abunda	1	1-3	6.8	19	38	38	95	A
		4-6	8.8	18	34*	33*	85	B
	2	4-6	15.1	17	36	29*	82	C
Tenderwhite	1	1-3	3.5	17	35	37	89	B
		4-6	5.9	16	35	38	89	B
Improved Hygrade	1	1-3	10.9	16*	38	38	92	B
		4-6	9.6	14*	36	36	86	C
	2	4-6	17.1	13*	38	31	82	D
Slimgreen	1	1-3	7.5	16	37	36	89	B
		4-6	13.5	17	39	31*	87	C
Resist Asgrow	1	1-3	8.5	18	37	31*	86	C
Valentine		4-6	8.5	18	36	30*	84	C
	2	1-3	23.4	13*	20	20	53	D
		4-6	20.1	14	30	21*	65	D
Contender	1	1-3	7.8	16	39	29*	84	C
		4-6	17.2	19	38	29*	86	C
	2	4-6	6.5	15	35	25*	65	D
Harris Shipper	1	1-3	3.0	18	39	38	95	A
Topmost	1	4-6	17.0	16*	40	38	94	B
Improved Tendergreen	1	1-3	13.1	12*	37	36	85	D
		4-6	19.3	13*	27	37	77	D
FM 187 C	1	1-3	14.9	19	38	39	96	A
	2	1-3	19.3	15	28	35	78	C
Green Cluster	1	1-3	2.9	19	36	37	92	A
		4-6	6.2	19	36	36	91	A
	2	1-3	2.9	18	32	32	82	B
		4-6	8.8	16	37	29*	82	C
Pearlgreen	1	4-6	3.9	14*	28	34	76	C
	2	4-6	8.9	14*	28	28*	70	C
Topcrop	1	1-3	5.0	18	39	37	94	A
		4-6	18.5	19	39	31*	89	C

* Indicates limiting rule

This page intentionally blank.

Table III - Snap Bean Variety Evaluation - Canned Product Data - 1962.

VARIETY	HARVEST	SIEVE SIZE	% BY WT. OF SEEDS	U.S. GRADE CLEARNESS OF LIQUOR	COLOR	ABS. OF DEFECTS	CHARACTER	TOTAL SCORE	GRADE
Bush Blue Lake	1	1-3	9.5	9	12	34	38	93	A
		4-6		10	14	33	36	93	A
Tendercrop	1	1-3	4.2	10	14	33	37	94	A
		4-6	6.5	9	14	31	34	88	B
	2	1-3	4.7	10	13	33	37	93	A
		4-6	9.6	9	14	34	34	81	B
Harvester	1	1-3	3.4	9	14	34	38	95	A
		4-6	5.8	9	14	33	35*	91	B
	2	1-3	5.0	9	14	34	37	94	A
		4-6	11.5	9	14	34	32	89	B
NK Executive	1	1-3	7.0	10	10*	34	37	94	C
		4-6	9.0	10	14	34	36	94	A
Harris Shipper	1	1-3	8.3	10	13	33	39	95	A
		4-6	9.3	10	13	30	35	88	B
NK Sprite	1	1-3	14.5	9	14	33	36	92	A
		4-6	10.0	9	14	34	35*	92	B
	2	1-3	6.9	9	13	33	34	89	B
		4-6	11.7	9	14	32	35*	90	B
VIP	1	1-3	4.4	9	13	34	39	95	A
		4-6	7.6	9	15	34	36	94	A
	2	1-3	3.5	9	12	31	36	88	B
		4-6	11.5	9	14	34	33*	90	B
Abunda	1	1-3	8.0	9	14	33	37	93	A
		4-6	8.0	9	14	31	35	89	B
	2	4-6	2.0	10	14	31	28*	83	C
Tenderwhite	1	1-3	5.7	9	14	33	39	95	A
		4-6	4.5	10	15	34	36	95	A
Improved Hygrade	1	1-3	1.4	9	14	34	39	96	A
		4-6	4.0	9	14	34	37	94	A
	2	4-6	4.5	9	14	33	36	92	A
Slimgreen	1	1-3	5.7	9	14	33	38	94	A
		4-6	12.2	9	14	33	33	89	B
Resist Asgrow	1	1-3	9.0	9	14	34	35	92	A
Valentine		4-6	11.0	7	13	32	29*	81	C
	2	1-3	25.0	8	11*	33	26	78	C
		4-6	26.5	7	14	32	25*	78	D
Contender	1	1-3	15.3	8	13	31	34	86	B
		4-6	16.4	4*	12	32	29	77	D
	2	1-3	8.7	9	11*	25	28*	73	C
		4-6	13.5	8	12	30	28*	78	C
Topmost	1	1-3	8.4	8	14	34	38	94	A
		4-6	9.0	9	15	34	36	94	A
Topcrop	1	1-3	8.9	9	14	34	38	95	A
		4-6	18.6	8	14	34	32	88	B
Improved	1	1-3	10.0	10	14	33	37	94	A
Tendergreen		4-6	17.6	6*	14	34	34	88	D
FM 187 C	1	1-3	6.5	9	12	33	38	92	A
		4-6	8.3	10	11*	34	35	90	C
Green Cluster	1	1-3	7.3	10	14	33	38	95	A
		4-6	7.7	10	14	33	36	93	A
	2	1-3	7.5	10	13	33	37	93	A
		4-6	9.1	9	13	33	31*	86	C
Pearlgreen	1	1-3	3.8	9	14	33	38	94	A
		4-6	8.1	8	14	34	34*	90	B
	2	1-3	11.5	10	13	33	35*	91	B
		4-6	12.8	10	13	33	33	89	B

* Indicates limiting rule

This page intentionally blank.

HANDLING AND HOLDING STUDIES OF MECHANICALLY HARVESTED TOMATOES
1. PROCESSED PRODUCT QUALITY

by W. A. Gould, W. D. Bash, J. R. Geisman, D. E. Yingst, G. A. Marlowe and W. N. Brown, Department of Horticulture, O.A.E.S.

Studies in 1962 were concerned with handling and holding practices of mechanically harvested tomatoes. This involved the use of a mechanical harvester, harvesting directly into large bulk containers and the subsequent transportation to The Ohio State University for holding and processing.

All tomatoes for this work were grown on test plots at the O. A. E. S. Northwest Substation, Hoytville, Ohio. Two varieties, H 1370 and Es 24, were used in the majority of the work. These varieties were harvested twice during the season, September 7 and 20. All harvesting, with the exception of the check samples which were hand harvested into hampers, was done with the FMC mechanical tomato harvester. The tomatoes were taken directly from the harvester into the bulk containers which were pulled along side the harvester on a farm wagon.

A total of eleven holding variables were used during the two harvests, however not all variables were used for both varieties for the two harvests. These holding variables are as follows:

1. Hand harvested into standard hampers (check).
2. Machine harvested into standard hampers.
3. Machine harvested into O.S.U. designed tote boxes 4' x 3' x 2'. These were made from 1" x 12" plank with a 1/2" space being left between the planks to allow for ventilation. These bins were filled to a depth of approximately 12" which gave a capacity of approximately 550 pounds.
4. Machine harvested into O.S.U. tote boxes lined with 4 mil polyethylene. The boxes were half filled with a 500 ppm chlorine solution with the tomatoes harvested directly into the boxes. The tomatoes were allowed to stand for 30 minutes before the polyethylene was slit to allow the solution to drain out. This type of treatment is referred to as a chlorine dip.
5. Same as 4 except a 1000 ppm chlorine solution was used.
6. Same as 4 except a 1000 ppm chlorine and 2500 ppm Klenzade Vega-Klean vegetable washing detergent was used.
7. Machine harvested into steel cherry holding tanks (4' x 3' x 4') which were filled to a depth of 18" with water before the tomatoes were harvested into them. Approximately 600 pounds of tomatoes were harvested directly into each tank. This provided a cushioning effect for the tomatoes but did not allow them to float free. The tomatoes were maintained in the same water throughout the holding period.
8. Same as 7 except 1000 ppm chlorine solution was used.
9. Same as 7 except a 500 ppm chlorine and 2500 ppm detergent solution was used.
10. Same as 7 except a 1000 ppm chlorine and 2500 ppm detergent solution was used.
11. Same as 7 except a 2500 ppm detergent solution was used.

As soon as possible after harvest, the containers were loaded onto a flat bed 1½ ton truck and transported to the Ohio State University, Department of Horticulture, Fruit and Vegetable Processing Pilot Plant. The distance from Hoytville to Columbus is approximately 100 miles. Throughout the 72 hour holding period all containers were held in an open parking lot behind the pilot plant.

Samples for processing were taken at 12, 24, 48, and 72 hours after harvest. At each sample period, random samples were taken from each of the bulk containers by sampling from the top to the bottom. Following sampling, the tomatoes (50 lb. lot) from each treatment were canned as whole tomatoes using acceptable commercial practices. The tomatoes were packed in number 303 plain tin cans, covered with juice, a standard sodium-calcium salt tablet was added, and they were retort processed for 20 minutes at 220° F. At the 72 hours

This page intentionally blank.

sampling time, juice was also processed from the samples. Following three months storage at room temperature, the tomatoes and juice were graded according to U.S. Standards for Grades for Canned Tomatoes (drained weight, wholeness, color, and absence of defects). In addition, color, pH, and total acid were determined before and after canning each lot.

As reported last year, drained weight of canned tomatoes appeared to be the best grade factor for determining the effects of different holding times and treatments of tomatoes prior to processing. General statements using only 1962 data relative to this phase of our studies can be made as follows (see Table I): (All statements are based on average drained weight figures (24 can samples) from the two harvest dates, September 7 and 20).

1. Those tomatoes hand harvested into standard hampers gave higher drained weight scores than any other treatment for both the H 1370 and ES 24 varieties.

2. There was very little difference in the drained weight scores between tomatoes machine harvested into hampers and machine harvested into tote boxes.

3. After the 12 hour holding period the drained weight scores obtained from tomatoes of the ES 24 variety held in the various water tank treatments declined rapidly throughout the remaining 60 hours of hold time. This reduction was not as great for tomatoes of the H 1370 variety, with the exception of those samples from the detergent solution treatment.

4. Those samples given the chlorine dip treatment had drained weight scores just slightly less than the samples from the dry tote box treatment.

Visual observations made on all samples at the time of grading indicated the chlorine dip samples were among the highest quality. Further, these lots appeared to have the highest raw product quality at the end of the hold period. However, mold and fly egg count indicated that the lots held in water were significantly lower than all other lots with the chlorine dip lots up to the 48 hour period about equivalent.

From this one year's study it would appear that the 30 minute chlorine dip treatment would provide the most desirable combination of reduction in bacterial spore load and retention of product quality. As presently planned, this work will be repeated and expanded during 1963.

This page intentionally blank.

Table I - Effect of Handling Treatment and Holding Times on Drained Weight of Canned Tomatoes

TREATMENT	TREATMENT NO.	NUMBER OF REPLICATIONS	AVERAGE DRAINED WEIGHT SCORES FOR TOMATOES HELD FOLLOWING HARVEST PRIOR TO CANNING 12 hrs.	24 hrs.	48 hrs.	72 hrs.
Hampers Hand Harvested	1	4	17.00	17.58	17.54	17.33
Hampers Machine Harvested	2	4	16.92	17.00	16.59	16.79
Tote Box Dry	3	4	17.75	17.20	16.63	16.38
Water Tank - Water Only	7	2	16.75	15.75	15.09	15.00
Water Tank - Water-Det.-Cl_2 (1000)[2]	10	4	16.38	16.09	15.49	15.33
Water Tank - Water-Det.	11	1	16.50	16.50	15.67	14.00
Water Tank - Water-Cl_2(1000)	8	2	16.09	15.00	14.82	13.92
Tote Box Cl_2 Dip (1000)	5	2	16.84	16.33	16.75	16.75
Tote Box Cl_2 Dip (500 ppm)	4	1	16.17	17.00	17.17	17.67
Tote Box Cl_2 Dip (1000)-Det.	6	1	16.17	16.33	16.33	17.17
Water Tank - Water Cl_2 (500)-Det.	9	1	16.50	15.33	15.33	13.83

Treatments are significant at the .05 level LSD = .23

Hours are significant at the .01 level LSD = .24

This page intentionally blank.

HANDLING AND HOLDING STUDIES OF MECHANICALLY HARVESTED TOMATOES
2. SPORE COUNTS

by Winston D. Bash and W. A. Gould, Department of Horticulture, O.A.E.S.

Due to some of the recent information regarding the possible contamination of mechanically harvested tomatoes with large numbers of bacterial spores, a study on bacterial spore loads was undertaken as a part of the total investigation on mechanically harvesting and holding of tomatoes. For example, the National Canners Association has reported situations where they have obtained aerobic spore counts on mechanically harvested tomatoes that were approximately 10 times the counts obtained from hand harvested tomatoes from the same plots.

It was felt that these bacterial studies should include sampling of the various holding treatments and bulk containers throughout the hold period in order to obtain another criterion on which to judge their effectiveness for mechanical tomato handling methods.

Samples for determining aerobic spore counts were taken immediately after harvest at the O.A.E.S. Northwest Sub-station Outlying Farm, Hoytville and then after the 100 mile haul by truck to the O.S.U. Fruit and Vegetable Processing and Technology Pilot Plant at intervals of 12, 24, 48, and 72 hours after harvest. Two sampling techniques had to be used since some of the holding treatments required the tomatoes to be in various detergent and/or chlorine solutions, while others were held completely in a dry condition. The procedure for obtaining the samples from the solution containing tanks was merely to slowly lower and raise an 8 ounce small mouth bottle in the tank until it was filled. Samples from those tomatoes held under dry conditions were obtained by weighing a representative four pound tomato sample and washing with four pounds of water in a covered container. This container was agitated for two minutes and the samples for analysis taken from the wash water. The sample taken from the chlorine dip treatments required a combination of both sampling techniques. For samples taken immediately after harvest, the water tank procedure was used and for the remaining samplings, the dry tomato method was used. All samples were taken in duplicate. The samples taken at the time of harvest were refrigerated until they could be processed at the laboratory (no more than an 8 hour hold), whereas all other samples were plated out as soon as possible after sampling. In addition, temperature and pH determination were made on each holding variable at the time of sampling.

The National Canners Association's recommendation for pasteurizing dilutions, plating, and incubating were closely followed. The procedure is as follows: An aliquot of approximately 30 ml. was taken from the sample bottles and placed in a large screw cap test tube for pasteurization. The tubes were placed in a 180° F. water bath and held in this bath for 10 minutes after their contents reached the 180°F. temperature. This ten minute pasteurization killed all the vegetative bacterial cells and left only the spores to germinate and grow during the incubation period. Immediately after pasteurization the tubes were cooled in running water. Aliquots from these tubes were diluted in sterile water blanks to give dilutions of 1/10 and 1/100. These dilutions were used to make four plates for which Tomato Juice Agar Special (Difco No. B 389) was used as the medium. Four plates were made from each of the duplicate samples giving a total of eight plates for each sampling period from each holding treatment.

All of the plates were incubated at 98° F. for 48 hours. At this time a total aerobic spore count from each plate was made and recorded.

Following are the results obtained from this one year's work (also see Table I):

1. The spore counts obtained from the hand harvested into hamper treatments were somewhat lower at the start of the 72 hour holding period than the counts obtained from the machine harvested into hamper treatment. However, by the end of the hold period, the two treatments gave counts that were almost equal.

2. The spore counts obtained from both the machine and hand harvested holding treatments were substantially lower than the counts obtained from the dry tote box treatment. This was true throughout the 72 hour holding period.

3. The highest average spore counts during the entire holding period were obtained from the water tank with water only treatment. These counts were approximately three times higher than that of the next highest treatment, which was the dry tote box treatment.

4. Spore counts obtained from water tank treatments using detergent and chlorine (1000 or 500 ppm) solutions as compared to chlorine solutions only, indicated very little difference between the two. On an average, these two types of treatments gave the lowest counts of all the holding variables.

5. The tote box chlorine dip treatment gave very low counts during the first 48 hours of the holding time. However, there was some tendency for the counts to increase at the 72 hour sampling period.

From this one year's study it would appear that the 30 minute chlorine dip treatment had the combination effect of reducing aerobic spore counts and retaining product quality in the processed product that was desirable from a mechanical type handling method.

This page intentionally blank.

Table I - Average Spore Counts of the Various Treatments by Hours After Harvest

TREATMENTS	REPLICATIONS	HOLDING TIME IN HOURS 0 hrs.	12 hrs.	24 hrs.	48 hrs.	72 hrs.
Hampers Hand Harvested	4	366	103	312	203	235
Hampers Machine Harvested	4	748	126	436	310	332
Tote Box Dry	4	987	677	528	351	897
Water Tank Det. and Cl_2 1000 ppm	4	120	25	75	144	178
Water Tank Water Only	2	1697	2544	1731	1523	1480
Water Tank Cl_2 1000 ppm	2	63	63	95	70	153
Tote Box Cl_2 1000 ppm Dip	2	151	288	35	67	2614
Tote Box Cl_2 500 ppm Dip	1	3	5	4	31	309
Tote Box Det. and Cl_2 1000 ppm Dip	1	1	53	40	48	35
Water Tank Det.	1	738	957	1225	850	863
Water Tank Det. and Cl_2 500 ppm	1	0	4	14	24	31

LSD at .01 for Sample Period NS

LSD at .01 for Treatment = 640

This page intentionally blank.

HANDLING AND HOLDING STUDIES OF MECHANICALLY HARVESTED TOMATOES
3. pH

by Winston D. Bash and W. A. Gould, Department of Horticulture, O.A.E.S.

Ever since water with the addition of detergents and chlorine has been considered for use in transporting mechanically harvested tomatoes, there has been a question as to their effect on the pH of the canned tomatoes. Since detergent and chlorine solutions often have a relatively high pH, it was felt that tomatoes held for any length of time in these solutions might be subject to higher pH levels, thus presenting a potential spoilage problem.

With this area of concern in mind, pH determinations from each of the holding variations at each sample time were taken. A Beckman pocket pH meter was used for all of these measurements. For those holding treatments using the water tanks, the pH readings were made directly from the holding solutions. Whereas, for those treatments where the tomatoes were held in a dry state, the pH readings were obtained from the wash water used to obtain the spore count samples.

The pH readings from the processed tomatoes were made at the time they were graded. A composite sample was obtained from the six cans graded from each treatment at each sampling period. These readings were made on a Beckman Zeromatic pH meter.

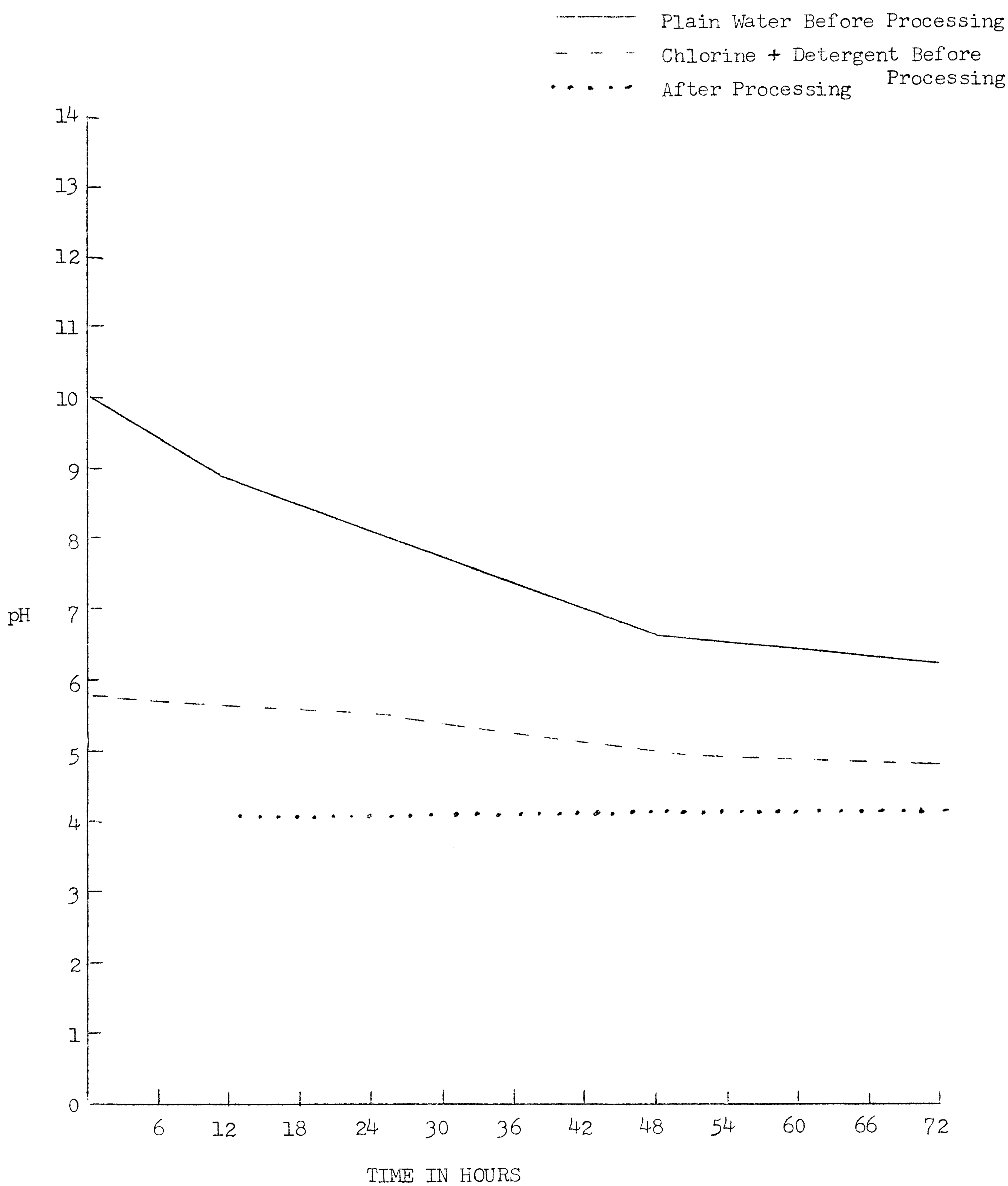
The data taken at the five sampling periods indicated that during the 72 hour hold the pH values decreased for all treatments. The amount of decrease was not constant; nor was the rate of decrease constant, these varied according to the treatments. However, there was a marked similarity in reaction for a given treatment between the two varieties ES 24 and H 1370, and the two harvest dates, September 7 and September 20.

The pH values obtained from the water tank treatments containing chlorine and detergent were by far the highest. Immediately after harvest these treatments had pH values of approximately pH 10. These decreased during the 72 hours to approximately pH 6.5. Those tanks containing only chlorine solutions had initial values of pH 8.5 and at the end of 72 hours values of pH 5.5. This decrease in pH was probably due to two factors: 1) Chlorine dissipation and 2) An acidification of the holding solution from broken or cracked tomatoes.

The detergent and chlorine dip treatments had high pH values similar to the water tank treatments at the first sampling; however, after the solutions were drained off, the pH dropped rapidly and values at the end of 72 hours were approximately pH 5.0. The lowest values were obtained from those treatments that maintained the tomato in a completely dry condition throughout the 72 hour holding period. The initial pH was approximately pH 5.5 and at the end of the hold period a pH of 4.8 was obtained.

The pH values obtained from the processed tomato samples indicated no effect due to the original pH of the tomatoes subjected to the various holding treatments and times. Regardless of the pH level at the time of sampling the processed tomato samples gave a pH value of approximately 4.2. This is clearly illustrated on Chart I.

CHART 1. pH Values Obtained from ES 24 Tomatoes Mechanically Harvested Into Water Tanks Before Processing (Tank Solution) and After Processing (3 mo. Storage).



This page intentionally blank.

HANDLING AND HOLDING STUDIES OF MECHANICALLY HARVESTED TOMATOES
4. CHLORINE RESIDUALS

by Donald E. Yingst and W. A. Gould, Department of Horticulture, O.A.E.S.

Chlorine compounds to purify water in North America was first attempted by Johnson (1911). The use of chlorine in the canning, freezing, and dehydrating of foods began with its addition to the water used for washing and rinsing equipment during routine cleaning periods. In 1931 the canning industry began to experiment with the addition of chlorine to water used for cooling heat-sterilized cans.

Development of the principles of "break-point" chlorination indicated the possibility of more extensive use of chlorine in food plants. The phenomenon of Break Point Chlorination may be briefly explained as follows: As chlorine is added to a water it will be found that the chlorine residual will increase. During this application of chlorine, typical flavors and odors associated with chlorinated water can be detected. With the addition of more chlorine, the chlorine residual decreases through the chemical reaction of the chlorine and substances known as chloramines are formed. As more chlorine is added beyond this point the residuals will then increase usually in direct proportion to the rate of applied chlorine. This reaction in the chlorine residual curve is known as the Break Point.

This strange reaction is accounted for by inherent factors present in the water. The first reaction as chlorine is added to a water is with various reducing substances, such as hydrogen sulfide and certain organic materials which may be in the water. The initial chlorine demand is the amount that reacts with these substances. When an excess is added above this amount most of it reacts with any ammonia present to form substances known as chloramines. The chloramines, however, are destroyed in proportion to the amount of excess chlorine residual after an equivalent amount of chlorine is added to the maximum amount of chloramine that could be formed.

Chlorine used for food plant sanitation is generally an aqueaus solution containing active chlorine which comes from one of three commercial sources: (1) liquid elemental chlorine, (2) hypochlorites, or (3) organic chloramine compounds.

There are many applications of chlorination in the food industry. The citrus concentrate industry uses in-plant chlorination in most of its processing plants , as well as a high concentration of chlorine in its germicidal wash scrubber units. The dairy and soft drink industry uses chlorination as a final rinse on its bottles prior to filling. The brewing industry uses chlorination to eliminate torulae yeast and other forms of wild yeast. This past summer, we, at The Ohio State University experimented with the application of chlorine in connection with our tomato water holding studies.

The varieties involved in this study were ES 24 and Heinz 1370 with the former variety being used for most of the experiments. The first harvesting of the tomatoes took place September 7 with the second harvest September 20. The containers used for this phase of the research project were steel cherry tanks and polyethelene lined tote boxes. The source of chlorine was Sodium Hypochlorite with 12.8% active material being added to the tanks and tote boxes at the rate of 1000 ppm. The solution in the containers consisted of either water and chlorine or water, detergent and chlorine. The tomatoes were then transported to The Ohio State University Pilot Plant.

Chlorine concentrations were determined by the starch-iodide method throughout the holding period. This method consists of allowing chlorine to react with iodide and titrating the liberated iodine with thiosulphate to a starch end point. Samples of tomatoes from the various treatments were removed and processed at 12, 24, 48, and 72 hours after harvest time. After a three month storage the processed tomatoes were opened and evaluated for grade and for any off flavor or odor.

Chlorine concentrations (Table I) are reported for tank treatments only since the solution remained in the tote boxes for only 30 minutes. Results indicate that the chlorine is broken down at a decreasing rate forming a logarithmic curve. With the additive of detergent to the water, the chlorine was slightly more stable than with chlorine alone. Chlorine was not broken down as rapidly in the tank containing tomatoes from the variety Heinz 1370. Further, chlorine was not broken down as rapidly for the second harvest as for the first, this can be partially explained by the cooler weather that prevailed at the time of the second harvest.

Observations of the finished product indicate that with the concentrations of chlorine used, tomatoes can be held up to 24 hours with no resulting off flavor or odor. However, samples processed after holding up to 48 hours from both the September 7 and September 20 harvests of variety ES 24 with a treatment of water and chlorine were found to have a slight off flavor and odor and a very noticeable off flavor and odor after the 72 hours hold time for the tomatoes from the September 7 harvest. A slight off flavor and odor was detected from samples of the variety ES 24 with the treatment water, detergent and chlorine after the 72 hour hold period from both harvests. There were no samples having an off flavor or odor from the 30 minute chlorine dip treatment.

The application of chlorine to the various treatments, although giving lower drained weight scores as reported in another paper and a slight off flavor and odor after 48 hours as reported in this paper, did give marked reductions in the bacterial spore counts. Further studies must be conducted before making a specific recommendation regarding the amount of free chlorine residuals for spore control, acceptable drained weights and an acceptable finished product from the standpoint of flavor and odor.

Table I - Residual Chlorine Value by Varieties, Harvest Dates and Holding Times.

Holding Time (in hours)	Chlorine Residuals in ppm: ES 24* Sept. 7	ES 24* Sept. 20	Heinz 1370* Sept. 7	Heinz 1370* Sept. 20	ES 24** Sept. 7	ES 24** Sept. 20	AVERAGE
0	880.4	818.0	1008.0	800.0	894.6	829.0	871.7
6	504.0	550.0	660.0	610.0	350.0	520.0	532.3
12	200.0	407.0	575.0	530.0	110.0	345.0	361.2
24	48.0	192.0	425.0	418.0	25.0	168.0	212.7
48	12.0	51.0	145.0	215.0	0.0	15.0	73.0
72	0.0	24.0	17.0	79.0	0.0	.9	20.2

* Initial concentration of 1000 ppm chlorine and 2500 ppm detergent.

** Initial concentration of 1000 ppm chlorine

This page intentionally blank.

REMOVAL OF INSECTS AND RESIDUES FROM SWEET CORN BY WASHING TECHNIQUES

by J. R. Geisman and W. A. Gould, Department of Horticulture, O.A.E.S.

Since there has recently been considerable interest in the removal of corn borers from sweet corn, a brief resume' of the findings of the research in this area is presented. The completed work is now being published as an Ohio Agricultural Experiment Station Research Bulletin and will be released shortly.

In order to adequately control corn earworms and borers, both field and in-plant control measures are necessary. However, this report is primarily concerned with in-plant procedures.

The insects represented two different problems. The earworm, being primarily a surface feeder, was easily removed in normal husking, silking and conveying operations, but partially devoured kernels and insect residues were left on the ear. On the other hand, the corn borer, entering the cob through the stalk, could not be removed by the normal unit operations involved in the processing of sweet corn. Therefore, the use of chemicals and specific washing techniques were evaluated in the pilot plant and commercial operation for effectiveness in removing corn borers and insect residues from sweet corn.

The data indicated that a chemical means of irritating the borers was necessary to stimulate them to crawl to the surface of the ear. Wetting agents and warm (100° F.) water were used to increase the effectiveness of the irritant. After the borers were on the surface of the ear, they were easily removed by a high pressure spray rinse of 150 p.s.i.

The recommendations for washing sweet corn based on the data obtained in this study are as follows:

1. Sweet corn for processing should be given a three-minute soak in warm (100° F.) water containing 83.3 p.p.m. pyrethrins and 0.25 percent detergent. The ears should be violently agitated during the soak period.

2. The soaking period should be followed by a high pressure (150 p.s.i.) spray rinse. Using a roller conveyor, the ears should make at least two revolutions while under the sprays. The nozzles should be placed seven inches above the rollers and the spray manifold should include at least two banks of full cone nozzles which deliver a square spray pattern and one bank of knife type nozzles. The number of nozzles will depend on the width of the conveyor and the length necessary to accomplish at least two revolutions of the ear while under the sprays.

3. Pyrethrins and detergents are not necessary during all stages of the sweet corn season, but only when corn borer infestation is evident.

4. High pressure spray rinsing should be used continually since it aids in reducing the amount of silk and other contaminants in the finished product.

5. These in-plant practices are merely an aid in manufacturing a quality product free of insect contamination. It is recommended that food production and handling practices precede the factory operations for control of insects infesting sweet corn.

This page intentionally blank.

REMOVAL OF PESTICIDES AND RADIOACTIVE FALLOUT FROM FRUITS AND VEGETABLES

by J. R. Geisman, R. P. Blackmore, R. W. Hirzel and W. S. Stinson,
Department of Horticulture, O.A.E.S. and O.S.U.

This report includes research being conducted in three project areas. These are: (1) the removal of pesticide residues, (2) the removal of radioactive fallout which occurs after the crop is harvested and (3) the removal of aged fission materials from products grown on soil contaminated with radioactive fallout.

For studies involving pesticides, it was necessary to evaluate detergents and washing techniques to determine whether there was a possibility of a detergent residue in the finished product. Therefore, three types of detergents varying in foaming characteristics were tagged with tritium. Tomatoes, with and without cracks, were used for each of the various soaking and rinsing operations. The results of these experiments indicate that the procedures recommended in O.A.E.S. Research Bulletin 825 for the washing of tomatoes leave no detergent residues in the finished product regardless of whether the tomatoes were cracked or not. Using moderate and high foaming detergents, the data indicate that the detergent concentration decreases rapidly due to overflow of foam and the possibility of a detergent residue in the finished product is increased. Further, when cracked tomatoes alone were used, there was a residue of both the high and moderate foaming detergents in the finished product.

These data were then used as the basis for selecting washing treatments to remove pesticide residues. Several concentrations of Aldrin tagged with radioactive carbon were applied to tomatoes. Washing experiments were conducted at one, three, and six days after applying the tagged aldrin. The preliminary results of these experiments seem to indicate that Aldrin can be washed from tomatoes by soaking and rinsing according to the recommended washing procedures. However, these results must be replicated and analyzed before the final conclusions can be drawn.

The removal of radioactive fallout is being studied from two viewpoints. First, what effect does unit operations such as washing, rinsing, or peeling have on reducing the amount of radioactive fallout on various crops. Several varieties of potatoes were tagged with Strontium 90. Peeling was accomplished by abrasion, abrasion with a wetting agent, hot lye and hand. Samples were dried and prepared for counting. This phase is not completed yet.

Secondly, what effect does different processing methods such as canning, freezing and dehydration have on reducing the amount of soil borne radioactivity in food products. Snap beans, spinach and potatoes have been processed and will be fed to rats. Samples of soil, fresh products, processed products and animal organs will be assayed for radiostrontium and radiocesium. Due to contractual arrangements with the U. S. Public Health Service, the results of this study cannot be reported until the project is terminated.

This page intentionally blank.

THE EFFECT OF APPLE VARIETY ADN BROWNING PREVENTION TREATMENTS DURING PREPARATION ON THE QUALITY OF FROZEN APPLE PIES

by D. Robert Davis* and James F. Gallander, Department of Horticulture, O.A.E.S.

One of the outstanding developments in the frozen food industry has been the rapid rise to prominence of frozen fruit pies. The rapid increase in the production of these pies has appreciably resulted in an increased demand for some fruits, particularly apples. In general, the research on the variety and maturity aspects of the fresh apples in relation to the quality of the finished, baked pies has not kept pace with the continuous changes in the pie filling formulations and processing methods.

This study involves the evaluation of three preparation treatments for the prevention of browning of fresh apple slices representing five varieties of apples, and to determine the effect of the treatments and varieties on the quality of the finished pies.

Each variety was subjected to the following treatments before they were incorporated into pies and frozen:

1. Pretreatment consisted of peeling into an 11 percent lemon juice solution, then draining before vacuum treatment.
2. Pretreatment consisted of peeling into 11 percent lemon juice solution, then directly subjecting to vacuum treatment.
3. Pretreatment consisted of peeling into a 2 percent salt solution, then draining before vacuum treatment.

The pie crust and the pie filling ingredients were essentially the same in each pie.

After a storage period of 6 to 8 months the pies of each treatment of the same variety were removed from the freezer and baked. The pies were then presented to a taste panel in such a way that each of the three treatments within a variety could be compared.

The study showed that the variety of apples had a highly significant effect on the flavor and texture of the pies but not on the color. The preparation or pretreatment of the slices had no significant effect on the flavor, texture, or color of the finished pies.

The effect of variety of apples on the quality of the pies was quite pronounced. The varieties Rome Beauty and Stayman Winesap were better in both flavor and texture than the other four varieties. Red Delicious was poorer in both flavor and texture than any of the other varieties. Thus, based on the quality attributes of flavor, texture and color, Rome Beauty would be the preferred variety to use with the given standard pie mix, followed by Stayman, Winesap, and Franklin, regardless of the three tested pretreatments.

The particular phase of the study concerning the flavor evaluations of each pretreatment within a variety to determine if any of the flavor differences caused by the pretreatment showed that only one variety, McIntosh, was significantly affected by the pretreatment.

The McIntosh apple slices which were subjected to pretreatment 2. produced pies which were significantly poorer in flavor than those pies made from apple slices which received either of the other two treatments.

In conclusion, the use of lemon juice as an agent to prevent browning or when injected into apple slices during preparation had no significant effect on the flavor of frozen pies made from these slices for all varieties except McIntosh.

---

* Present address: Food Research and Development Division, Colgate-Palmolive Co., New Brunswick, New Jersey

This page intentionally blank.

EFFECT OF THREE TOMATO PEELING METHODS ON EFFICIENCY AND PRODUCT QUALITY

by Wade A. Schulte and W. A. Gould, Department of Horticulture, O.A.E.S. and O.S.U.

This study is a continuation of the tomato peeling study initiated in 1961. The original study was modified in the following areas in 1962: (1) Acidification was omitted, (2) Cold lye dip treatment was omitted, (3) The fruit in each variety were divided into two lots, small and large, (4) A wetting agent (Sterox CD) was added to the hot lye solution, and (5) Core loss was determined.

Sixteen varieties of tomatoes grown at the Northwest Sub-station of the Ohio Agricultural Experiment Station were used in this study. They were size graded upon arrival. In processing the following peeling procedures were used: (1) Continuous 212° F. steam scald for 45 seconds (control), (2) Agitating lye dip 190 - 200° F. for 25 seconds followed by a one minute hold (lye reaction time) prior to washing to remove the lye, and (3) Continuous 22 second Infra-red exposure at 1500° F.

The lye (caustic soda) concentration was controlled to 18 - 20% by weight. The fruits were cored with a Hydrout tomato corer after the lye dip operation and the waste was determined for each lot. Peel times were recorded and the amount of peel removed was weighed directly. All tomatoes were processed in 20 pound lots. After approximately a three month storage period, the samples were graded according to the procedures set forth by the U. S. Standards for Grades of Canned Tomatoes. The following tables summarize the results.

Table I - Effect of Peeling Method and Size of Tomatoes On Efficiency (percent core, percent peel, and pounds peeled per man hour) and Quality (pH and Total Acid). (Average values for 16 varieties of tomatoes replicated three times in 1962).

PEELING METHOD	SIZE OF FRUIT	NUMBER OF FRUIT PER 25 lb.	% CORE	% PEEL	POUNDS PEELED PER HOUR	pH	TOTAL ACID
Steam	Small	87.5	5.2	7.8	305	4.28	0.469
	Large	57.5	3.2	7.0	352	4.30	0.461
Lye	Small	87.0	4.5	2.9	533	4.30	0.455
	Large	56.5	2.8	2.4	741	4.32	0.445
Infrared	Small	83.0	4.7	5.7	232	4.28	0.445
	Large	53.0	3.2	5.0	261	4.31	0.455

A higher percentage of core waste, a higher percentage of peel waste, and a slower peeling rate was experienced in processing those lots of tomatoes composed of small fruit as compared to those lots of tomatoes composed of large fruit. When the three peeling methods are compared, the greatest amount of peel had to be removed from the control, i.e., the steam scald lots. The least amount of peel was removed from the lye dip lots, while the infra-red lots were in between these two extremes. When peeling rate is considered, the lye dip lots were by far superior, followed by the steam scald lots and the infra-red lots respectively. The wetting agent which was used in conjunction with the lye facilitated complete lye action, and, as a result, the majority of the peel was removed from the fruit as it was conveyed over the roller conveyer to the peeling belt. Also, some of the peel was loosened and inadvertedly removed due to handling in the coring operation. Many fruits merely needed to be checked for remaining peel. Difficulty was encountered in peeling the infra-red lots due to small pieces of peel which were loose but clinging to the tomato. Consequently, the peeling rate was low for these lots.

It is clearly evident that little difference in pH, if any, exists due to peeling methods.

Table II - Grades of Canned Tomatoes by Peeling Method and Fruit Size - 1962**

	PEELING METHODS BY SIZE OF TOMATO FRUITS					
	STEAM		LYE		INFRA-RED	
GRADE FACTORS	SMALL	LARGE	SMALL	LARGE	SMALL	LARGE
Drained Weight ozs.	10.77	10.77	10.87	10.88	10.89	10.91
Drained Weight points	17.3*	17.3*	17.9*	17.9*	17.9*	17.7*
Wholeness points	16.1	16.4	16.4	17.2	15.1	16.4
Color points	27.7	28.7	27.5	28.3	28.0	28.5
Absence of Defects points	29.6	29.4	29.5	29.6	29.2	29.1
TOTAL SCORE	90.7	91.8	91.3	93.0	90.2	91.7
GRADE	B	B	B	B	B	B

* Indicates limiting rule

** Data represents averages of 16 varieties.

The data in Table II indicate that there is little, if any, difference in quality due either to peeling method or fruit size. The attribute of wholeness shows the greatest variation, ranging from 15.1 (low Grade B) to 17.2 (high Grade B). The lower wholeness score for the small infra-red lot is most likely due to the fact that the small tomatoes had to be forced onto the spindles thereby damaging the fruit.

Conclusions:

1. Large fruit can be peeled more efficiently than small fruit.

2. Lye peeling is more efficient than steam scalding or infra-red peeling.

3. All three peeling methods will yield a finished product of similar quality.

4. Fruit size has little or no effect on the quality of canned tomatoes except for possibly wholeness.

EFFECTS OF COOLING RATES ON VACUUM OF CANNED PUMPKIN

by Winston D. Bash, Department of Horticulture, O.S.U.

Several requests from the industry on the effects of vacuum on cooling rates indicated an investigation was needed. In reviewing the literature on vacuums in thermal processed tin cans, there was an abundant amount of material on methods of producing vacuums and the reasons why canned food should be processed with vacuums. However, there appeared to be a lack of information of the effects on vacuum of rate of cooling, pressure cooling, and product quality. For this reason a project was initiated to obtain information in these areas.

Pumpkin was selected as the test product, mainly because of its availability at the time of processing, and secondly because of its slow heating and cooling rates. The pumpkin was processed under commercially acceptable procedures and filled into number 303 C-enamel tin cans at a temperature of 180° F.

Eighteen cans were used as a test batch. After filling, the cans were closed on an AMerican Can Co. No. 00, Model 6 Steam Injection Head Sealing Machine. The steam flow head was used to obtain three different vacuum levels. The cans were closed under the following schedule of steam flow head pressures:

NUMBER OF CANS	STEAM FLOW HEAD PRESSURE
6	0.0 psi
6	7.5 psi
6	15.0 psi

All processing was done in a FMC pilot model retort equipped with a Foxboro Pressure On-Off Controller Model 40, and Foxboro Temperature Controller and Recorder. All 18 cans from one batch were processed at one time.

The following schedule was used for the processing variables:

PROCESSING TEMPERATURE	PROCESSING TIME	COOLING TIME	COOLING PRESSURE	COOLING TEMPERATURE
240°F.	72 minutes	25 minutes	0.0 psi	50°F.
240°F.	72 minutes	25 minutes	7.5 psi	50°F.
240°F.	72 minutes	25 minutes	15.0 psi	50°F.
250°F.	60 minutes	25 minutes	0.0 psi	50°F.
250°F.	60 minutes	25 minutes	7.5 psi	50°F.
250°F.	60 minutes	25 minutes	15.0 psi	50°F.

One batch of 18 cans was processed under each of the six sets of processing variables. Immediately after processing, the cans were removed from the retort and all except two cans from each vacuum treatment were stored at room temperature until evaluated.

Immediately after cooling, 6 cans from each batch (2 from each vacuum level) were checked for center can temperature. The four remaining samples were evaluated in the following manner: 1) vacuums were taken on each can; 2) visual observations were made on the physical condition of each can; 3) a slump test was performed on the pumpkin from each can. This was done by emptying the contents of the can onto a grading tray and measuring the pumpkin height after two minutes; 4) soluble solids were determined on the pumpkin from each can by taking readings with aid of the Abbe Refractometer; and 5) color measurements were made by using the Agtron F colorimeter.

This page intentionally blank.

The data obtained indicated three important facts regarding center can temperature after cooling. First, the cans processed at 250° F. for 60 minutes gave slightly lower temperatures than those processed at 240° F. for 72 minutes. This difference was approximately 2 - 3 degrees. Second, the higher the vacuum, the lower the center can temperature. The samples closed at 0 psi steam flow head pressure (average vacuum 8 in.) had a center can temperature of approximately 8 degrees higher than the cans closed at 15 psi (average vacuum 16 in.). Third, the higher the cooling pressure, the lower the center can temperature. There was a difference of about 4 degrees between those samples cooled at 0 psi. and those cooled at 15 psi. Those samples cooled at 15 psi. and at the higher vacuum, exhibited severe paneling which may have caused a faster cooling rate. However, there was no paneling on the samples cooled at 7.5 psi., and there was still a marked reduction in temperature between them and the 0 psi. cooled cans.

There was one important observation made in regard to the vacuums of the processed cans, as would be expected, the higher the steam flow head pressure, the higher the vacuum produced within the can. However, the higher the cooling pressure within any given steam flow head pressure range, the lower the vacuum of the cans. This can be explained for the high cooling pressure, due to the degree of can distortion, but at the 7.5 psi. cooling pressure there was no observable damage and there was still a sharp decline in can vacuum.

The data obtained from the product quality phase of this study was inconclusive; however, additional work is planned for the coming year.

This page intentionally blank.

NEW FLAVORS FOR SAUERKRAUT

by J. R. Geisman and Robert Reyda, Department of Horticulture, O.A.E.S.

The primary objective of this study was to increase the use and acceptability of sauerkraut through the development of new flavors.

New Flavors:
Two acceptable new flavors were developed, a sweetened kraut and a sweetened garlic-flavored kraut. However, with both of these products, a darkening was obtained when processed in plain tin cans. Therefore, a study was undertaken to eliminate this color problem and to evaluate other flavoring materials for use in sauerkraut.

Samples of sauerkraut were packed in polyethylene-terphthalate-aluminum foil-vinyl plastic pouches. Each package was filled with five ounces of drained kraut shredds and three ounces of brine were added. Various flavoring materials were mixed with the brine as shown in Table I.

Table I - Concentrations of Flavoring Ingredients and Acidity of Sauerkraut Samples Packaged in Flexible Film Pouches.

Percent Acidity (as lactic)	Ingredients and Concentration Used (Percent by Weight)
1.5*	0
1.2	0
1.2	60° Brix corn syrup
1.2	60° Brix corn syrup and .01% garlic concentrate
1.2	.01% Smoke concentrate
1.2	.01% Spice mixture
1.2	.01% Frankfurter concentrate
1.2	.01% Caraway concentrate

* A sample of this lot was also packed in #303 plain tin cans for comparison.

The samples packaged in the flexible pouches were processed at 220° F. for 20 minutes. All samples were stored at room temperature for three weeks to reach an equilibrium and were then evaluated for color and flavor.

After three weeks storage, the control samples packaged in tin cans were slightly darker than the control samples packaged in flexible films. Samples containing the spice mixture and frankfurter concentrate were considerably darker colored than the other samples. There was no difference in color in the control lots and those containing flavoring ingredients other than the two mentioned above.

The results of the flavor evaluations are listed in Table II. Samples were rated on a 1 to 10 scale with 1 equal to off-flavor and 10 equal to excellent.

The results indicate that there were no detectable differences in flavor between the control lots. Spice mixture and frankfurter concentrate were unacceptable as flavoring ingredients for sauerkraut. The concentration of caraway was too intense to be acceptable; however, the panel indicated that this flavor could possibly be acceptable if used in a more dilute concentration. Both the sweetened kraut and the sweetened kraut with garlic concentrate added were rated as acceptable by the panel. The samples which contained smoke flavoring were rated nearly as high as the control samples. This indicates that smoke flavoring could be added to sauerkraut to create an acceptable new flavor.

This page intentionally blank.

Table II - Average Flavor Ratings of Flavored Sauerkraut Samples.

SAMPLES	AVERAGE FLAVOR SCORE
1.5% acid (tin)	8.6
1.5% acid (film)	8.6
1.2% acid	8.6
1.2% acid plus 60° Brix corn syrup	6.0
1.2% acid plus 60° Brix corn syrup plus .01% garlic	7.3
1.2% acid plus .01% Smoke	8.5
1.2% acid plus .01% Spice	2.7
1.2% acid plus .01% Frankfurter	1.7
1.2% acid plus .01% Caraway	4.9

Those samples packaged in flexible films have another advantage over conventionally packaged sauerkraut in that these packages can be heated in boiling water. This would overcome one of the main objections of homemakers to sauerkraut, that is, strong aroma.

New Products:
Perhaps the phase of this study showing the most potential is the development of new products. Recent work in this area has been the development of vegetable protein-sauerkraut combinations. This phase has been accomplished in cooperation with Worthington Foods, Inc.

Samples of sauerkraut were packaged in combination with either "ham" or vega-links (which resemble weiners) in varying amounts as shown in Table III. Twelve ounces of sauerkraut and four ounces of 1.5% acid, as lactic, brine were filled in #303 plain tin cans.

Table III - Amounts of Vegetable Protein Ingredients Added To Sauerkraut Samples.

Vegetable-Protein Ingredient	Weight (oz.)
Ham	1/2
Ham	1/4
Ham	3/4
Vega-links	1 1/2
Vega-links	3/4
Vega-links	1/2

Samples containing ham were rated higher than the samples containing vega-links. All samples were rated as equal to or better than the control samples. Samples containing 3/4 ounce of ham were rated highest and preferred to all others.

These results have been obtained after two weeks storage and additional storage studies will be required. However, the potential from these products is realized in that (1) the combination can be processed at the same time and temperature as sauerkraut, (2) the meat-like products produce a desirable effect on flavor and (3) the combination is equal to or preferred to sauerkraut. Thus, it is hoped that these new products and packages will aid in increasing the consumption of sauerkraut.

This page intentionally blank.

FLAVOR OF TOMATO JUICE

by Wilbur A. Gould, Natholyn Dalton and John Hal Johnson,
Department of Horticulture, O.A.E.S. & O.S.U.

Much interest has been given in recent years on the effect of specific food additives (citric acid, salt, and sugar) on the flavor of tomatoes, particularly tomato juice. It has been suggested that tomato juice should be acidified by adding citric acid. Due to the use of extra salt by some consumers when serving tomato juice, the increase in the normal amount of added salt has been a practice by some tomato juice processors. Further, due to the difference in inherent soluble solids content between East-Midwest and West Coast canned tomato juice, it has been suggested that the East-Midwest tomato juice processor might consider the addition of sugar to tomato juice.

Experimental tomato juice samples were prepared using several different varieties of tomatoes. Salt (30 grain additional/303 size container), sucrose (2 and 4 percent), and citric acid (to lower the pH 0.3 and 0.6 pH units) were added to tomato juice. These samples were evaluated after 3 months storage as to the effects of these additives on the quality of tomato juice. Flavor as determined by a 10 member taste panel was one of the criteria used for evaluating the effects of these additives on quality of tomato juice.

When citric acid is added alone to tomato juice, it has an adverse effect upon the flavor of tomato juice; however, when additional sugar is added along with the citric acid, the juice was rated as acceptable. As increased amounts of acid are added to the juice, an increased amount of sugar must be used to counter-balance the effect of their low pH on the flavor of tomato juice. However, there is a point at which no additional sugar appears to improve the flavor. Additional salt decreases the flavor of tomato juice; however, if additional sugar or acid are present together with the additional salt, then no significant differences exist in the flavor scores.

We have concluded that additional salt beyond the 30 grains per 303 size can or equivalent is not necessary nor desirable. Further, flavor in tomato juice is a function of the sugar-acid ratio. That is, if low acid tomatoes are used in the manufacture of tomato juice, these tomatoes should contain sufficient sugar to off-set the low inherent pH or additional sugar should be permitted as an additive to obtain the desired flavor of tomato juice.

We are presently following these studies on flavor by separation, identification, and determination of the volatile compounds or essences of tomato juice. These volatile compounds are the odorous materials which can be removed by heating the juice to boiling temperature. They are collected by a steam distillation apparatus which is carefully controlled to approximate conditions similar to boiling the juice and to allow removal of the maximum amount of volatiles from the juice. Through an extraction procedure, the volatiles are further concentrated. Less than one drop of volatile compounds are collected from a quart of juice.

Analysis of this small amount of tomato juice volatile is accomplished by using Gas Liquid Chromatography. This method of analysis permits separation of individual compounds depending on their boiling point and other chemical properties, and the determination of the amount of volatile compounds present.

Using this research technique, juice from several tomato varieties have been compared. The preliminary data show that varietal differences in volatile materials is due to differences in the quantity of the specific compound present rather than differences in the kind of compounds. It is further evident that heat processing eliminates a few of the volatile compounds and, in general, the volatile compounds are quantitatively reduced by the heat treatment required to sterilize the juice.

This page intentionally blank.

FRUIT JUICE BLENDS

offer a promising new field for apple cider

D. ROBERT DAVIS

Juice was one of the first products prepared from apples, and until the early 1930's was probably consumed in greater quantities than any other fruit juice. The most significant development in recent years in the field of commercially processed juices has been the canning of non-carbonated fruit juices in a variety of flavors, both ready-to-serve and concentrated.

Market Expanding

There are definite indications of continued market expansion for fruit juice drinks. Although the most noticeable trend is that towards "ades", "drinks" and "nectars" rather than necessarily towards juices, recent studies have indicated that fruit juice blends using cider as the blend base can produce highly acceptable high quality juice blends.

Cider Blend Used

Recent tests incorporated as a base a cider blend consisting of Stayman Winesap, Jonathan,

The fresh and canned cider-fruit juice blends were presented to a taste panel consisting of 8 to 14 members and each drink was presented separately and in random order so they could not be compared with one another. Each juice blend was given a flavor score ranging from 1 (poor) to 9 (excellent) and all flavor scores averaging below 5 were considered to be unacceptable.

Results Studied

The results show that the fresh and pasteurized cider-strawberry blends were preferred over all other blends, including plain cider. The fresh cider-grape juice blends were rated equivalent to cider, but pasteurizing apparently adversely affected the flavor of these juice blends. Although the 9/10 cider, 1/10 sour cherry blend was rated equivalent to plain cider, these blends did not score as high as expected and it was found that an addition of sugar greatly improved their acceptability. The cider blend containing 2 percent lemon juice was rated high when served both as fresh juice or canned and the panel further indicated that this blend would make a very pleasing breakfast beverage. The cider and lime juice apparently were not com-

This page intentionally blank.

patible and resulted in an off-flavor product.

Blends Presented

During a meeting of the Ohio State Horticultural Society blends of plain cider, cider and juice from 4-plus-1 frozen strawberries, and cider and grape juice were presented to 110 members for rating in order of preference. The results indicated that the cider-strawberry juice blend was preferred over plain cider.

Orange Oil Preferred

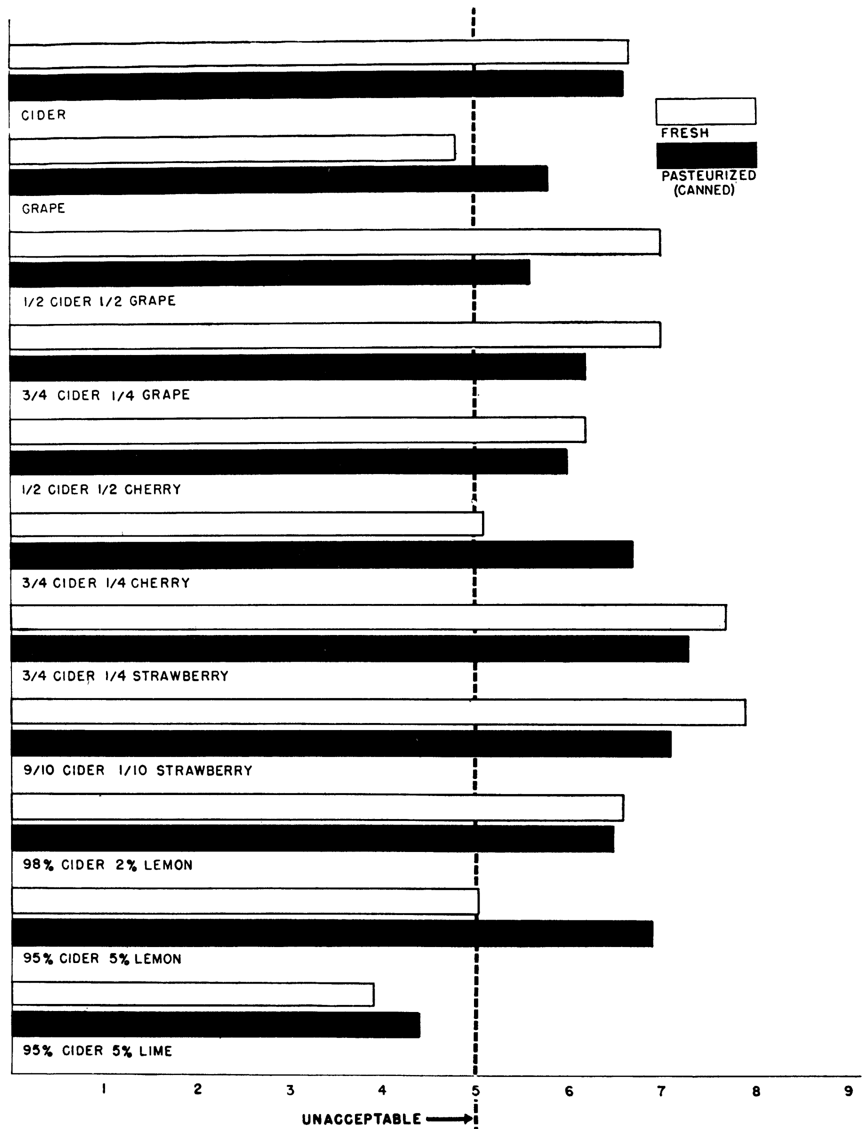
At a more recent meeting 47 persons evaluated juices consisting of plain cider, cider and juice pressed from cull peaches at a concentration of 9/10 cider, 1/10 peach juice, and cider from apples containing one orange peel per bushel of apples. The results indicated that the cider containing the orange oil was the preferred drink. Although over half the panel rated the cider-grape and cider-peach juice blends as the preferred, one should not infer that these blends would not be acceptable.

Check Labeling

It should be cautioned that anyone interested in producing fruit juice blends for sale contact the Ohio Department of Agriculture, Division of Food and Dairies, and the Food and Drug Administration, U.S. Department of Health, Education and Welfare, regarding the labeling of such products to assure that their labels will comply with the Ohio Food, Drug, Cosmetic and Device Law and the Federal Food, Drug, and Cosmetic Law.

Results of Taste Panels Involving Fresh Cider and Cider-Fruit Juice Blends

	Preferred Blend	Rated Second Best	Least Preferred Blend
	(Percent)	(Percent)	(Percent)
Cider	42	31	27
Cider-Strawberry Blend	47	35	18
Cider-Grape Juice Blend	11	34	55
Cider	25	46	29
Cider-Peach Juice Blend	20	29	51
Cider-Orange Oil Blend	55	25	20



TASTE PANEL SCORES

This page intentionally blank.

This page intentionally blank.

This page intentionally blank.