PROCESSING and TECHNOLOGY

of

FRUITS and VEGETABLES

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HORTICULTURAL PRODUCTS DIVISION

of the

DEPARTMENT OF HORTICULTURE

THE OHIO AGRICULTURAL EXPERIMENT STATION

THE OHIO STATE UNIVERSITY

in cooperation with

THE OHIO AGRICULTURAL EXTENSION SERVICE

RESEARCH PROGRESS REPORTS

JANUARY, 1961

1827 Neil Avenue
Columbus 10, Ohio

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TOMATO VARIETY EVALUATION FOR PROCESSING - 1961

by W. A. Gould, J. R. Geisman and Wade Schulte

The 1960 tomato variety trials included fourteen varieties which grew in replicated plots under acceptable commercial practices at Columbus, Ohio. Each variety was harvested at regular intervals.

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

Size or Average Count per 25 Pounds - The total number of tomatoes per 25 pounds.

Raw Grade - The U. S. Grade was determined in accordance with the U. S. Standards for Tomatoes for Canning. The number 2's were separated into those that were 2's for COLOR and those that were 2's for DEFECTS. All grading was done using the Macbeth (Examolite) daylight type lamp with no other light (artificial or natural) interfering.

Agtron F - The Agtron "F" values were determined using 70 as a standard. Samples were taken at the extractor and from the finished canned juice after approximately three (3) months' storage.

Total Acid - Determined by direct titration and calculated as percent citric acid.

pH - Determined with the Beckman Zeromatic pH meter.

Vitamin C or Ascorbic Acid - Determined by Dye titration and calculated as milligrams per 100 grams.

Percent Soluble Solids - Determined from the refractive indice using the Abbe '56 refractometer.

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

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

Viscosity - Determined by using an efflux tube (GOSUC) - Consistometer using a 5/64 inch opening and standardized at 23 seconds at 25° C. with water.

Hunter L, a and b - Determined with the Hunter Color and Color Difference Meter. This instrument was standardized at L, 25.59; a, 27.40 and b, 12.54.

Department of Horticulture, OAES, Mimeo Series No. 221, January, 1961.

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Table I - Tomato Variety Evaluation - Summary Raw Product Data - Columbus, 1960
(Detailed data on Hort. Dept. Mimeo - 217)

VARIETY	AVERAGE COUNT PER 25#	PERCENTAGE YIELD BY HARVEST 8/17	8/30	9/19	10/7	T/Acre	%No.1	%No.2C	%No.2D	% Culls
Cardinal Hybrid	78.3	-	39.5	20.3	40.2	15.29	58.7	12.0	26.0	3.3
Morton Hybrid	79.8	10.6	43.9	14.5	31.0	15.63	49.3	14.7	31.6	4.4
Fireball	125.1	23.9	47.4	1.5	27.2	12.35	57.1	11.4	21.2	9.3
Glamour	90.3	-	28.8	25.6	45.6	16.96	67.5	19.8	10.1	2.6
KC - 135	72.5	-	21.9	42.1	36.0	16.63	74.8	14.0	10.3	0.9
KC - 146	73.4	-	23.1	28.5	48.4	21.68	72.8	14.2	11.5	1.5
Hoytville No. 6	82.0	-	38.6	18.8	42.6	16.23	60.2	15.9	21.7	2.2
Rutgers	105.1	-	27.4	34.0	38.6	12.16	65.8	11.5	18.9	3.8
Heinz 137	94.6	-	37.0	12.7	50.3	21.64	74.8	12.8	9.3	3.1
Epoch	102.3	-	36.5	17.7	45.8	11.19	65.0	11.4	17.0	2.6
Plainsman	93.7	7.0	44.2	13.9	34.9	15.13	61.7	12.0	20.7	5.6
C - 52	141.8	5.8	44.4	17.9	31.9	13.33	70.9	13.9	12.3	2.9
Hotset	139.5	12.6	46.4	13.1	27.9	13.15	67.4	11.7	16.4	2.5
Urbana	114.8	6.1	39.2	24.4	30.3	17.32	69.9	13.9	14.0	1.9

Table II - Tomato Variety Evaluation - Objective Quality and Chemical Analysis - Raw Product Data - Columbus, 1960

VARIETY	QUALITY	HUNTER - PULP COLOR			AGTRON	pH	% CITRIC ACID
		L	a	b			
Cardinal Hybrid	No.1	24.2	21.7	9.55	38.5	4.1	.544
	No.2	24.7	19.4	9.65	55.3	4.0	.546
Morton Hybrid	No.1	24.8	21.8	9.67	36.2	4.14	.493
	No.2	27.1	20.4	11.1	54.5	4.18	.550
Fireball	No.1	25.4	19.6	10.6	34.7	4.18	.465
	No.2	26.1	23.3	10.6	59.5	4.0	.515
Glamour	No.1	23.3	19.8	9.45	37.0	4.16	.454
	No.2	27.8	21.3	12.0	73.3	4.02	.486
KC - 135	No.1	24.2	22.6	9.45	39.0	4.11	.527
	No.2	29.3	23.3	12.1	78.3	4.0	.576
KC - 146	No.1	25.7	24.2	10.4	45.3	4.11	.515
	No.2	27.4	21.9	11.0	76.7	4.03	.561
Hoytville No. 6	No.1	24.8	22.1	10.3	41.0	4.18	.450
	No.2	26.0	21.4	10.6	63.0	4.1	.444
Rutgers	No.1	25.0	21.8	10.2	46.0	4.15	.461
	No.2	29.7	24.5	13.6	87.7	4.0	.544
Heinz 137	No.1	25.2	22.7	9.5	40.0	4.07	.472
	No.2	27.1	21.4	11.5	70.3	3.86	.530
Epoch	No.1	25.7	23.4	10.8	41.3	3.9	.574
	No.2	27.9	21.2	12.3	82.5	3.8	.634
Plainsman	No.1	23.9	17.1	9.5	35.0	4.0	.563
	No.2	26.7	18.1	11.1	65.3	3.88	.550
C - 52	No.1	24.3	20.1	9.43	28.3	3.97	.595
	No.2	26.1	17.2	11.2	54.3	3.87	.627
Hotset	No.1	24.5	25.6	10.3	33.0	3.8	.533
	No.2	26.8	18.4	11.3	68.3	3.77	.648
Urbana	No.1	24.3	18.4	9.63	37.3	4.02	.514
	No.2	27.4	19.9	11.7	72.7	3.97	.512

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Table III - Tomato Variety Evaluation - Subjective, Objective and Chemical Analysis of Tomato Juice (Average of replicates for field ren tomatoes - all lots processed by 'cold break' double extract, flash pasteurized.)

VARIETY	COLOR	CONS.	DEF.	FLAVOR	AGT.	HUNTER L	HUNTER a	HUNTER b	pH	% CITRIC ACID	VIS.	SOL. SOLIDS	T.S.	GRADE
Cardinal Hybrid	28.3	15	15	36	48.3	25.2	17.6	11.6	4.07	.474	39.9	4.6	94.3	A
Morton Hybrid	28.0	15	15	38	47.7	25.5	16.9	11.4	4.07	.474	40.3	4.3	96.0	A
Fireball	30.0	15	15	38	41.0	24.5	17.1	11.1	4.2	.429	40.0	5.5	98.0	A
Glamour	27.5	15	14.5	37	48.5	25.4	17.1	11.5	4.2	.432	39.4	4.8	94.0	A
KC - 135	27.7	15	14.7	38.7	47.3	25.3	17.4	11.5	4.13	.518	38.7	4.3	96.1	A
KC - 146	26.7	13.3	14.7	37.3	50.0	26.1	17.5	12.1	4.1	.538	38.5	5.4	92.0	A
Hoytville No. 6	28.3	15	15	37.7	48.3	25.6	18.2	14.6	4.2	.456	40.5	5.2	96.0	A
Rutgers	28.0	15	15	39	47.0	26.0	17.3	12.2	4.2	.461	38.7	5.0	97.0	A
Heinz 1370	28.7	15	15	37.7	49.0	25.6	18.2	11.8	4.13	.510	42.6	5.5	96.4	A
Epoch	27.0	14.3	15	34	52.0	26.4	19.3	12.1	4.13	.584	39.7	5.07	90.3	A
Plainsman	26.0	10	15	30	53.0	25.3	13.6	10.5	4.2	.493	38.0	3.7	81.0	C
C - 52	26.0	15	15	33	51.0	26.0	16.7	12.4	4.0	.557	39.7	4.5	89.0	A
Hotset	25.0	10	15	33.5	49.0	25.8	16.9	11.6	3.9	.634	37.7	5.1	83.5	C
Urbana	27.5	14	15	33	51.5	25.5	15.6	11.5	4.05	.525	37.3	5.25	89.5	A

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Table IV - Tomato Variety Evaluation - Canned Tomato Data, Columbus, 1960
(all lots processed from Field Run Tomatoes)

VARIETY	NO. OF HARVESTS	pH	% CITRIC ACID	DR. WT.	WHOLENESS	COLOR	ABS. OF DEF.	TOTAL	GRADE
Cardinal Hybrid	3	4.14	.492	19.2	17.7	27.4	28.1	92.4	A
Morton Hybrid	3	4.07	.524	18.5	16.1	27.2	27.6	89.4	B
Fireball	1	4.13	.442	19.3	17.2	27.3	27.8	91.6	A
Glamour	3	4.19	.468	18.6	17.6	28.1	28.4	92.7	A
KC - 135	3	4.08	.541	19.6	17.0	27.0	23.9*	87.5	B
KC - 146	3	4.05	.513	19.3	17.4	27.8	28.2	92.7	A
Hoytville No. 6	3	4.18	.451	19.4	17.3	28.0	28.4	93.1	A
Rutgers	2	4.26	.495	19.1	14.7	26.1*	28.3	88.2	B
Heinz 1370	3	4.12	.476	19.2	17.9	27.4	28.3	92.8	A
Epoch	2	4.06	.550	19.4	14.2	25.6*	28.0	87.2	B
Plainsman	3	4.14	.525	18.8	15.8	27.8	28.6	91.0	A
C - 52	2	4.13	.483	19.4	15.8	28.3	28.8	92.3	A
Hotset	2	4.08	.553	19.1	17.0	28.4	26.8*	91.3	B
Urbana	2	4.18	.506	19.7	16.3	26.7*	28.6	91.3	B

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EVALUATION OF SWEET CORN VARIETIES FOR PROCESSING

by J. R. Geisman and W. A. Gould

The sweet corn evaluation trials included thirteen varieties. The corn was planted June 7, 1960, in rows (2 rows each with 230 hills per row). Each variety was harvested at various stages of maturity and processed as cream style corn. All the corn was canned using the following standard formuls:

corn	- 74.0%
water	- 18.5%
sugar	- 5.0%
salt	- 0.5%
starch	- 1.5%

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

Growth Degree Days - Calculated by using 50°F. as the base temperature using the Columbus, Ohio, Weather Bureau Data.

Specific Gravity - Determined on a 100 gram sample of cut corn as follows:

$$\text{Specific gravity} = \frac{\text{wt. of corn in air x specific gravity of water}}{\text{wt. of corn in air - wt. of corn in water}}$$

Percent AIS - Determined on a 10 gram sample in accordance with the F & DA Alcohol Insoluble Solids (AIS) method for the minimum standards of Quality for Canned Sweet Corn.

Diameter of Kernels - Determined by measuring the total width of 20 kernels.

Conisitency - Determined with the aid of the Adams Consistometer. The Adams Consistometer values range from 1 (thin) to 18 (thick). The filler samples were determined on hot camples at the filler and the canned product was determined after approximately 3 months storage.

WDR Values - The Washed Drained Residue (WDR) was determined by washing a sample of corn on an eight mesh screen and weighing the residue remaining on the screen and calculating the percent remaining on the screen.

U. S. Grade - The U. S. Grade was determined in accordance with the U. S. Standards for Grades of Canned Cream Style Corn.

Ave. Ear Width - Determined by measuring the total width of 20 ears and dividing the total by 20.

Ave. Ear Length - Determined by measuring the total length of 20 ears and dividirg the total by 20.

Seed Source and Lot Number - The seed source and lot number are listed below each variety in Table 1. The abbreviations are as follows:

A - Asgrow
ML - Michael-Leonard SRS
H - Harris
R - Rogers
NK - Northrup-King
FM - Ferry-Morse

Department of Horticulture, OAES, Mimeo Series No. 222, January, 1961.

Table 1. - Raw Product Data for Sweet Corn Varieties by Harvests - Columbus, 1960

VARIETY	HARVEST DATE	GROWING DAYS	GROWTH DEGREE DAYS	SPECIFIC GRAVITY	%AIS	DIAMETER 20 KERNELS	AVE. EAR LENGTH	AVE. EAR DIAMETER
Deep Gold	8/30	85	1802	1.105	23.0	5.8"	7.2"	1.5"
(A-43036-F32)	9/2	88	1886	1.113	23.2	6.1	7.1	2.1
	9/7	93	2012	1.115	27.0	6.1	7.2	2.2
Golden Sensation	8/30	85	1802	1.105	22.4	8.1	8.1	1.8
(ML-3357994)	9/2	88	1886	1.112	21.9	8.0	8.2	1.8
	9/7	93	2012	1.140	30.0	8.5	8.1	1.9
Gold Cup	8/24	79	1649	1.096	21.6	6.0	6.3	1.7
(H-1858)	8/29	84	1773	1.115	24.5	6.6	7.5	1.9
	9/7	93	2012	1.145	33.4	6.9	7.3	2.0
Golden Sensation	8/30	85	1802	1.095	19.2	6.8	8.3	1.9
W.P.	9/6	92	1982	1.113	25.6	7.5	8.9	2.1
(ML-20569)	9/13	99	2090	1.116	-	7.4	8.4	2.1
Golden Hybrid 2378	8/24	79	1649	1.085	15.8	6.1	7.3	1.8
(R-88044)	8/29	84	1773	1.108	23.2	7.1	7.5	1.9
	9/7	93	2012	1.140	30.1	7.3	7.3	1.9
Dominator Hybrid	8/30	85	1802	1.134	28.8	8.1	7.9	1.8
(R-98001)	9/6	92	1982	1.157	33.0	8.0	7.9	1.9
NK 87	8/30	85	1802	1.101	20.8	6.2	7.8	2.0
(NK-3027/1994)	9/6	92	1982	1.107	24.0	6.7	8.1	2.2
	9/13	99	2090	1.105	-	7.6	7.8	2.2
NK 1304	8/30	85	1802	1.120	26.0	7.1	7.9	1.8
(NK-3063/83)	9/6	92	1982	1.143	28.9	7.7	7.4	1.9
NK 81-51027	8/29	84	1773	1.120	26.3	6.9	7.8	2.0
(NK-3027/1987)	9/2	88	1886	1.125	27.7	7.1	7.9	2.1
	9/7	93	2012	1.134	29.0	6.8	8.0	2.1
Finegold MF_2	8/29	84	1773	1.104	12.9	6.3	8.7	2.0
(ML-3369981)	9/6	92	1982	1.130	26.0	6.5	8.7	2.1
Tenderfine	8/29	84	1773	1.110	23.0	5.8	7.4	1.9
(ML-3349981)	9/6	92	1982	1.123	23.1	6.8	7.4	2.0
	9/13	99	2090	1.137	-	7.0	6.2	2.0
Mellowgold WS	8/24	79	1649	1.101	22.3	10.0	8.3	2.0
(R-98022)	8/29	84	1773	1.130	26.8	8.4	8.4	2.1
	9/7	93	2012	1.154	35.9	8.7	8.3	2.1
Hybrid 102A	8/23	78	1626	1.088	18.7	6.8	8.0	2.1
(FM-28415)	8/24	79	1649	1.107	-	6.8	7.0	2.1

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Table 2. - U. S. D. A. Grades by Factors of Quality and Other Quality Data for Each Variety at Each Harvest for Canned Cream Style Corn - Columbus, 1960

VARIETY	HARVEST	U. S. D. A. Grade Factors: COLOR	CONSISTENCY	ABSENCE OF DEFECTS	TENDERNESS AND MATURITY	FLAVOR	TOTAL SCORE	GRADE	Adams Consistency: FILLER	CANNED	% WDR
Deep Gold	1	8	15**	20	27	19	89	C	0.25	4	31.25
	1***	8	16	20	27	18	89	B	1.0	6.25	31.25
	2	8	16	20	26**	17	87	B	0	5.75	37.5
	3	8	17	20	23**	15**	83	C	0	7.75	43.75
Golden Sensation	1	8	17	20	26**	17	88	B	3.25	7	28.12
	2	9	18	20	27	17	91	A	2.5	8	50.0
	3	8	18	20	25**	17	88	B	6.25	10.5	46.87
Gold Cup(1)	1	8	15**	17**	27	18	85	C	0	3.75	25.0
	2	8	16	17**	26**	17	84	B	4.5	5	25.0
	3	8	17	17**	24**	17	83	B	1.00	7.25	40.62
Golden Sensation WP	1	8	19	20	27	17	91	A	5.25	10	43.75
	1***	8	16	20	27	18	89	B	4.5	5.75	25.0
	2	9	18	20	22**	14**	83	C	6	9	43.75
	2***	9	15**	20	22**	17	83	C	3	5	34.37
	3	8	15**	20	21**	10**	74	D	3.25	6.25	50.0
Golden Hybrid 2378	1	8	14**	20	27	17	86	C	0	1.5	28.12
	2	8	17	20	28	18	91	A	1	4.25	25.0
	2***	8	17	20	26**	18	89	B	2	6	34.37
	3	8	19	20	22**	14**	83	C	4.75	11	56.25
Dominator Hybrid	1	9	19	20	23**	18	89	C	5.75	10	40.62
	2	9	17	20	22**	14**	82	C	6.5	7.5	37.5
NK 87	1	8	17	20	26**	18	89	B	4.25	7.25	31.25
	2	8	14**	20	22**	14**	78	C	4	5.5	34.37
	2***	8	16	20	22**	16	82	C	1	6.25	37.5
	3	8	16	20	21**	13**	78	D	2.25	8.5	53.12
NK 1304	1	9	16	20	25**	17	87	B	3.5	6.25	21.87
	1***	9	18	20	24**	15**	86	C	3	9.25	37.5
	2	9	17	20	20**	13**	79	D	4	7.25	43.75

Table 2. (continued)

VARIETY	HARVEST	U. S. D. A. Grade Factors COLOR	CONSISTENCY	ABSENCE OF DEFECTS	TENDERNESS AND MATURITY	FLAVOR	TOTAL SCORE	GRADE	Adams Consistency FILLER	CANNED	% WDR
NK 81-51027	1	8	18	20	25**	16	87	B	1.5	7	37.5
	2	9	18	20	22**	14**	83	C	4	8	37.5
	3	8	18	20	22**	15**	83	C	2	8.5	50.0
Finegold MF_2(1)	1	8	16	20	27	17	88	B	0	3.75	28.12
	2	8	13**	17**	27	18	79	D	0	2.5	34.3
Tenderfine	1	8	14**	20	27	18	83	C	0	3	25.0
	2	8	14**	20	23**	14**	79	C	0	5	37.5
	3	8	16	20	21**	14**	79	D	3	9	59.37
Mellowgold WS	1	9	19	20	22**	16	86	C	5.5	9	34.37
	2	9	17	20	22**	14**	82	C	5.5	14	43.75
	3	8	16	20	21**	13**	78	D	5.25	15.5	59.37
Hybrid 102A	1***	8	14**	20	28	20	90	C	3.5	0	21.87
	2***	8	17	20	28	20	93	A	4	6.25	34.37
	3***	8	15**	20	27	17	87	C	3	3.5	25.0

(1) - Denotes varieties which had brown silk.
** - Indicates limiting rule within grade classification.
*** - When sufficient quantity of sweet corn was obtained, a duplicate batch was processed using a different starch ingredient.

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SMALL FRUIT VARIETY EVALUATION STUDIES FOR FREEZING

by D. R. Davis and H. L. Stammer

STRAWBERRIES

The strawberry variety studies during the 1959-1960 season included the evaluation of 16 varieties. All varieties were harvested twice during the season, sliced, mixed with sugar in a 4-plus-1 ratio (4 parts strawberries to 1 part sugar) and frozen. After a storage period of 6 to 8 months the varieties were evaluated, both chemically and organoleptically.

Taste panel results showed the variety Earlidawn to be outstanding, ranking first in color and texture and also, along with the variety Surecrop, first in flavor. Midway, a variety being introduced for the first time this year, was of exceptionally high quality. Beside the above named varieties, Tennessee Beauty, Belmar, and Orland were also considered good varieties for freezing. Sparkle, a variety which had scored high in past years, was rated only fair in this year's study. Pocahontas was not included in this season's study, but previous variety trials have shown it to be equal to Earlidawn and is highly recommended. The popular Robinson and Premier varieties were both rated poor for freezing.

BLACK RASPBERRIES

Eight varieties were included in the black raspberry variety studies. Using Bristol as a standard, a comparison was made between the fruit when frozen with no sugar treatment (IQF), in 30°, 40°, and 50° Brix syrups, and mixed with sugar in a 3-plus-1 ratio. The results showed that fruit packed in the syrup solutions were significantly higher in color, texture, and flavor than fruit from the other treatments. However, there was no significant difference between fruit packed at the three different syrup concentrations.

There was no significant difference between varieties in the 3-plus-1 frozen black raspberries. When the fruit was packed with no sugar treatment the Bristol and Morrison varieties were significantly higher in quality. The fruit packed in 40° Brix syrup showed a variation in quality between varieties and maturity within a variety, particularly in color. In the earlier harvest the varieties Morrison and Sono had significantly higher color scores, while Bristol had a significantly better color in the later harvest.

Department of Horticulture, OAES, Mimeo Series No. 223, January, 1961

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EVALUATION OF APPLES FOR PROCESSING

I. FRUIT JUICE BLENDS

by D. R. Davis and H. L. Stammer

To further increase the use of apples in Ohio by commercial processors a study was initiated on canned apple-fruit juice blends consisting of cider from eight apple varieties blended with strawberry, grape, lemon and lime juice.

The fruit juices in all cases were blended with the cider before filtering. None of the fruit juices contained added water or sugar, although the strawberry blends were made from the juice of 4-plus-1 frozen strawberries. The cider-fruit juice blends were pasteurized by heating the blend to 170°F. in a stainless steel kettle, filling into bottles and sealing, cooling in air for 10 minutes, then placing in hot (130°F.) water for several minutes and finally cooling to room temperature in air. The cider-grape juice blends contained concentrations of $\frac{1}{2}$ grape juice, 1/3 grape juice, and $\frac{1}{4}$ grape juice. The cider-strawberry blends contained strawberry juice in concentrations of 1/3 strawberry juice, 1/4 strawberry juice, and 1/10 strawberry juice. In the cider-lemon and cider-lime juice blends the cider concentration was 90 percent.

Results have shown that the variety of apple was apparently the most important factor for consideration in obtaining a high quality juice. The apple-strawberry blends were consistently rated higher than the apple blends containing grape, lemon, or lime. Only in the Stayman Winesap-strawberry juice blends did the quality of the canned juice measure up to that of the fresh cider or the fresh apple-strawberry blends. When juice from the varieties Melrose, Red Delicious, Rome Beauty, Jonathan, and McIntosh were blended separately with strawberry juice a musty, off-flavored product resulted in the canned juice.

Similarly, juice from the varieties Melrose, Golden Delicious, Rome Beauty, and Jonathan produced off-flavors when blended with Concord grape juice and canned. When the cider was blended with lemon or lime juice in concentrations as low as 10 percent lemon or lime, the resulting canned blend was too tart to be considered acceptable. Only the canned cider-lemon juice blends of Golden Delicious were considered to be satisfactory.

Based on their compatibility with other juices and the resulting relatively higher quality after canning, cider from the varieties Stayman Winesap and Ruby appeared to have the highest potential in the development of competitive apple-fruit juice blends.

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EVALUATION OF APPLES FOR PROCESSING

II. CANNED APPLE SLICES

by D. R. Davis and H. L. Stammer

The processing of apples into apple slices for commercial bakeries has for many years been an important outlet for apples. The potential of this market has not yet been reached in Ohio. To ascertain the acceptability of Ohio grown apples for this market 15 apple varieties have been evaluated.

The apple slices used in this study were canned in accordance with commercially accepted procedures. The apples, after washing, peeling, coring and trimming were sliced into a 2 percent salt solution. The slices were then rinsed thoroughly, placed into a vacuum chamber and deaerated, then the vacuum was released with steam. Following a cold water spray they were filled into cans and covered with boiling water, exhausted, sealed, processed, cooled and stored at room temperature.

After a storage period of 4 to 6 months the samples were chemically evaluated for pH, total acids, and soluble solids. The samples were also graded in accordance with the U. S. Standards for Grades of Canned Apples. The graders consisted of members of the staff and students of the Horticultural Products Division. The score points of the important factors and the U. S. Grades of each variety are presented in Table I.

Table I - Score Points and U. S. Grades for Canned Apples

VARIETY	COLOR SCORE	CHARACTER SCORE	GRADE
McIntosh	14.7*	24.1*	SStd.
Ruby	16.0*	33.9*	C
Cortland	16.9*	34.2	C
Turley	16.8*	35.1	C
Stayman Winesap	14.8*	35.7	C
Red Delicious	18.0	37.0	A
R. I. Greening	15.7*	32.8*	C
Northern Spy	17.8	35.6	A
Franklin	17.1	33.8*	C
Melrose	16.5*	34.2	C
Jonathan	17.5	34.7	A
Grimes Golden	16.9*	35.2	C
Baldwin	15.1*	34.0	C
Rome Beauty	14.7*	34.1	C
Golden Delicious	18.5	36.1	A

* Limiting Rule.

Four of the 15 varieties were graded U. S. Grade A and of these four varieties; Red Delicious, Golden Delicious, and Jonathan are considered among the most important and most plentiful varieties grown in Ohio.

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EVALUATION OF APPLES FOR PROCESSING

III. FROZEN APPLE SLICES

by D. R. Davis and H. L. Stammer

To further encourage the use of apples in commercial processing a study was initiated to determine the acceptability of frozen apple slices made from Ohio grown apples. Fifteen apple varieties were included in the study.

The procedure for the preparation and freezing of the apple slices consisted of washing, peeling, coring, trimming, and then slicing the apples into a 2 percent salt solution. The slices were then rinsed, submerged in a 40° Brix syrup solution containing 0.2 percent ascorbic acid, deaerated in a vacuum chamber, then the vacuum was released and the syrup solution was allowed to replace the air within the apple slices. After rinsing, the slices were mixed with sugar at a 5-plus-1 ratio, filled into containers, and covered with water containing 0.2 percent ascorbic acid. The containers were then sealed and quick frozen.

After a 4 to 6 month storage period the samples were removed from the freezer, allowed to thaw, and were chemically and organoleptically evaluated. The slices were graded by the staff and students of the Horticultural Products Division in accordance with the U. S. Standards for Canned Apple Slices. The score points of the important factors and the Grades of each variety are presented in Table I.

Table I - Score Points and Grades for Frozen Apples

VARIETY	COLOR SCORE	CHARACTER SCORE	GRADE
McIntosh	17.3	36.1	A
Ruby	15.9*	31.1*	C
Cortland	15.9*	33.9*	C
Turley	15.8*	32.9*	C
Stayman Winesap	17.5	34.1	A
Red Delicious	17.4	34.5	A
R. I. Greening	15.4*	35.2	C
Northern Spy	17.1	34.5	A
Franklin	15.9*	35.2	C
Melrose	18.0	33.1*	C
Jonathan	18.6	36.2	A
Grimes Golden	17.2	36.2	A
Baldwin	16.4*	35.0	C
Rome Beauty	14.9*	34.0	C
Golden Delicious	17.7	36.0	A

* Limiting Rule.

Seven of the fifteen varieties were scored U. S. Grade A using the score sheet for canned apples. All of the more important apple varieties grown in Ohio scored U. S. Grade A except Rome Beauty.

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EVALUATION OF APPLES FOR PROCESSING

IV. FROZEN FRUIT PIES

by D. R. Davis and H. L. Stammer

The production and consumption of frozen fruit pies has been increasing at a rapid rate in the past few years. Previous studies on frozen fruit pies have been concerned primarily with maintaining crust quality and developing suitable filling ingredients other than the fruit. This study is concerned basically with the effect of variety and pretreatment of the apples on the quality of the frozen fruit pies.

Fifteen varieties of apples were used in this study. Each variety was subjected to the following treatments before they were incorporated into pies and frozen:

1. No treatment. Fresh apple slices were combined with the other filling ingredients, placed into a bottom crust and covered with a top crust, then sealed in pie boxes and frozen.

2. Frozen apple slices. Pies were made in the same way except frozen apple slices were used in place of fresh slices.

3. Canned apple slices. Pies were made with canned apple slices in place of the fresh or frozen apple slices.

The pie crust and the pie filling ingredients were essentially the same in each pie, as was the concentration of each ingredient.

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

The pies made from the fresh apple slices and those made from the frozen apple slices were all rated as acceptable, regardless of the variety. The pies made from the fresh slices of the varieties Red Delicious, R. I. Greening, and Northern Spy were considered to be the best of those made with the fresh slices. The color of these pies were good, but in most varieties the slices were mushy since the fresh slices were not subjected to a vacuum treatment to firm the slices prior to their incorporation into the pie.

The pies made from the frozen apple slices generally produced the best pies. In some varieties, however, the slices in the baked pie were firm to a point that they had the texture of uncooked slices. This was considered objectionable since the panel preferred the pies in which the slices were soft and tender. Those varieties producing the best pies from frozen apple slices were Grimes Golden, Stayman Winesap, Cortland, Franklin, and Jonathan.

The pies made from canned apple slices were usually rated lower than those from the other two treatments except when the Turley and R. I. Greening varieties were used. These varieties produced pies from canned apple slices which were as good as or better than those made from fresh or frozen slices. The actual color of the slices within the pie did not seem to effect the scoring, since it was masked by the other filling ingredients. The main objection to the pies made from canned apples was the texture. In most varieties the individual slices were tough and appeared to be dehydrated. The pies made from canned apples of the varieties; McIntosh, Melrose, and Red Delicious were the poorest and were considered as unacceptable when compared to those made from the fresh or frozen slices.

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A STUDY OF SEVERAL VARIETIES OF PUMPKIN AND SQUASH FOR CANNING AND FREEZING FOR USE IN PIES

by Robert H. Clayton, J. R. Geisman, and W. A. Gould

Since different varieties of pumpkin and squash result in wide differences in consistency, color and flavor in the canned or frozen product, this study was undertaken to determine the effects of varieties, processing variables and ingredients (spices and spice mixtures) on the quality of pumpkin pies. Further, methods for determining consistency of pumpkin and squash products were also examined.

Pumpkin and squash varieties were prepared and processed according to accepted commercial practices. Each variety was divided into two lots. One lot was heat processed while the other was frozen. Color, percent soluble solids, percent alcohol insoluble solids, slurry-Adams Consistometer values and percent sag were the quality factors evaluated before processing and after storage. After two months storage, the canned and frozen products were made into pies using a standard recipe. The pies were evaluated for flavor according to the multiple comparison test developed by eleven laboratories in cooperation with the National Canners Association.

The results indicated that a Hunter Color and Color Difference Meter "a" value of plus 6 was the dividing line between acceptable and non-acceptable pie colors. Color, flavor and texture differences among pumpkin and squash varieties when made into pies were small and difficult to distinguish by the panelists. All straight varietal purees, whether canned or frozen, resulted in acceptable pie flavors. However, complete pie mixes and different spice formulas had unacceptable flavors when baked into pies.

The varieties with low percent soluble solids in the raw product increased in percent soluble solids during storage, while varieties having high percent soluble solids in the raw product decreased in percent soluble solids during storage. For purposes of predicting consistency of the canned purees, percent soluble solids and the blotter test on the raw product gave highly accurate results. However, for predicting consistency of the frozen product, alcohol insoluble solids and the blotter test were most reliable.

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FACTORS EFFECTING THE CONSISTENCY OF CREAM STYLE CORN

by D. R. Davis and W. A. Gould

A study has recently been completed which involved some of the more important factors believed to effect the consistency of cream style corn. Several different factors were considered in this study: (1) variety, (2) maturity, (3) addition of water, (4) amount and type of added starch, (5) storage time and (6) the storage temperature.

The variety of corn was shown to have a significant effect on the consistency pattern of the cream style corn after storage. Three varieties were tested and the ability of a variety to "set up" in consistency during storage was shown to be different in each variety.

The maturity of the corn at the time of processing was considered in relationship to the amount of water to be added during the blending and mixing operation. Through objective maturity tests of the raw corn a maturity-added water relationship can be established, so the only variable during the entire season would be the maturity of the corn, which can be compensated by the addition of pre-determined amounts of water.

The amount of added starch was shown to have the most significant effect on the consistency of the cream style corn. It was further shown that starch should be added to each batch of corn at a concentration of approximately 1 percent, and this addition should remain constant throughout the season. The addition of a waxy maize starch in preference to a linear starch does produce a higher quality product.

If the cream style corn is packed following the above suggestions, that is, know the consistency pattern of the variety, use the maturity-added water relationship to control the water addition, and add a waxy maize type of starch, the storage time and storage temperature will have little effect on the consistency of the cream style corn over a storage period of at least 4 months.

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THE OBJECTIVE MEASUREMENT OF TOMATO JUICE CONSISTENCY

by Robert Kluter and W. A. Gould

During the past few years an intensive study has been conducted on the objective measurement of tomato juice consistency. Government and commercial interests have expressed concern over the considerable variation in the consistency of the commercial product as disclosed by comparative grading sessions, using the United States Standards for Grades of Canned Tomato Juice.

Juice from 17 tomato varieties was objectively measured for consistency on seven different viscosimeters. The 17 lots of tomatoes were processed in the Department of Horticulture, Division of Horticultural Products' Pilot Plant. Standard commercial procedures were followed in the processing operations. Samples from each lot were stored at 40°; 70°; and 90°F. for a period of three months and then evaluated on the following instruments:

1. USDA viscometer
2. OSU Efflux-tube viscometer
3. OSU Modified Efflux-tube (GOSUC) consistometer
4. Capillary viscometer
5. Stormer viscosimeter
6. Brookfield viscometer
7. Gardner mobilometer

During the preliminary studies the USDA viscometer measurements resulted in low correlations with both the efflux-tube viscometer and the modified efflux-tube (GOSUC) consistometer; thus it was discontinued from the study. The GOSUC consistometer had some advantages over the original efflux-tube viscometer; thus it was the only one of the three that was used in the primary study.

The data obtained from the primary studies indicated that neither the Brookfield viscometer nor the Gardner mobilometer produced satisfactory results. It was evident from the examinations of the data that these two instruments were not sensitive to differences in consistency that were found by the orifice and constant force types of instruments. The three remaining instruments all gave satisfactory consistency readings that could be correlated, but the Stormer viscosimeter was the least preferred. The Capillary viscometer was considered the second most desirable instrument for measuring consistency. The GOSUC consistometer has been selected as the most acceptable means of obtaining comparative consistency measurements because of its simplicity of design, reproducibility, sensitivity, and correlation with other measuring devices.

The Efflux-tube viscometer and the modified Efflux-tube viscometer (GOSUC consistometer) were developed at the Ohio State University Horticultural Products Laboratory. It consists of a blown-glass reservoir sloped into a 2 mm. orifice on the efflux and a three-quarter-inch orifice at the top, which enables the pouring of the sample into the reservoir through a funnel or the filling of the reservoir by vacuum. A piece of rubber tubing attaches a metal plug with a 5/64-inch (2 mm.) precision-bore orifice. This allows the flow to be stopped by a pinch-clamp and the instrument to be accurately standardized by adjusting the length of rubber tubing. Consistency is measured in seconds required for the efflux of 200 ml. of juice.

The following table gives the consistency of tomato juice as determined by the GOSUC consistometer, 1958 variety trials. These figures represent the average consistencies of the samples after three months storage:

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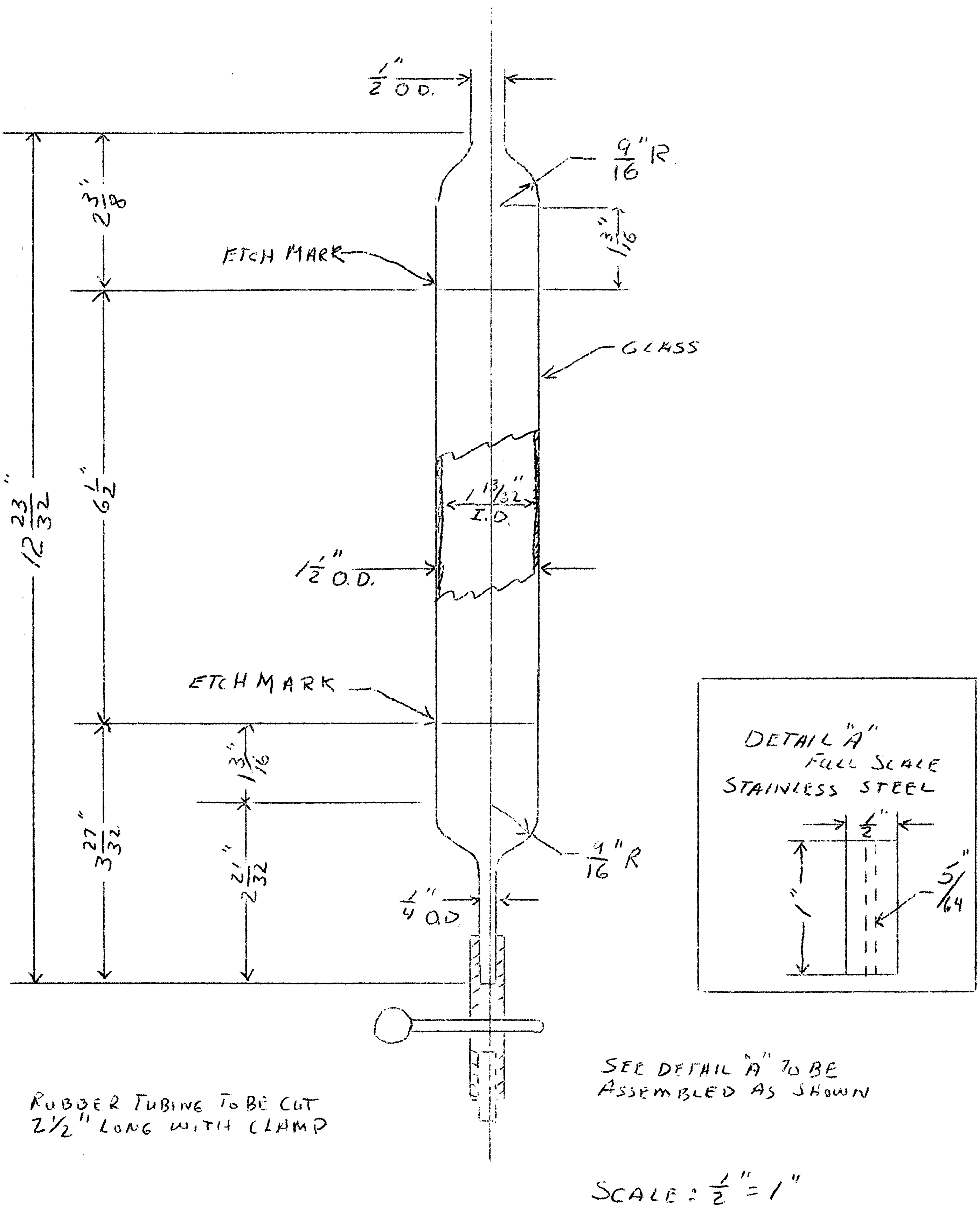
Table 1 - The Consistency of Tomato Juice as Determined by the GOSUC Consistometer

VARIETY	CONSISTENCY IN SECONDS
Franklin F2	40.1
Wisconsin 55	40.8
Foremost F-21	40.8
KC 146	41.9
WR Jubilee	42.6
Glamour	43.1
Ace	44.3
Stokescross #6	44.3
Improved Garden State	45.7
Rutgers	45.9
Hoytville # 5	47.4
Red Top	60.1

CONSISTOMETER OF GOSUC



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A METHOD FOR THE DETECTION OF DROSOPHILA FLY EGGS AND LARVAE IN TOMATO PRODUCTS

by J. R. Geisman and Winston D. Bash*

Much work has been done on methods of detection of extraneous matter in food. Of the possible sources of contamination, the Drosophila fly is probably the most serious problem confronting the tomato processor today. The female fly will lay eggs in cracked tomatoes, and these eggs may be found in the finished product. Therefore, a processor must have facilities to determine the number, if any, of Drosophila eggs and/or larva in his product. Further, the method should be rapid and accurate so that it could be used as a quality control tool to prevent the processing of lots of unknown "contamination." Such a method has been developed, using ultra-violet light (GOSUL) to aid in the detection of eggs and larvae.

The primary concern of technologists utilizing the GOSUL technique has been to relate the results of this method with those obtained by the official F & DA method. This cannot be done because of the dissimilarity of the methods. It has been stated by Food & Drug Administration personnel that with samples containing known numbers of added eggs the expected recovery was approximately 70 percent when using the official method. Further, tremendous variation has been shown between similar samples and between analysts. In laboratory and field tests of samples with known quantities of added eggs, 100 percent recovery was obtained with the GOSUL technique. Therefore, increased egg counts would be expected with the GOSUL method as compared to the official method; but due to the variability in separating the eggs from tomato tissue when using the official method, no general comparison as to the percent increase in egg count can be made.

Since the GOSUL technique is being evaluated for possible adoption as the official method, another problem is being raised. That is the quantity of eggs in tomato products which will comply with F & DA recommendations. If the GOSUL method is adopted it is evident that substantial change will have to be made in the manner in which the F & DA establishes their working tolerances.

Since at least 13 Ohio canners are using the GOSUL technique, the procedure is presented in detail in order to establish uniform results.

Equipment

- 100-Watt long wave (3660 A) ultra-violet light source
- #5 Buchner Funnel
- 18.5 or 20 cm. "Sharkskin" filter papers
- 2000 ml. filtering flask
- 2 - 500 ml. beakers
- 9" x 9" glass or plastic plate
- Aspirator pump or other vacuum source
- Binocular wide-field microscope (10x) or 10x hand lens
- 100 ml. graduate cylinder
- Teasing needle
- 1 pair tweezers
- Vinegar (40 or 50-grain) or 4 or 5% acetic acid

Preparation of Sample

1. Thoroughly mix sample. This can be accomplished by vigorously shaking the sample in a container in an up-and-down motion 200 times.
2. Open container and pour a 100-ml. aliquot of sample into graduate cylinder.

* Agricultural Extension Specialist in Food Processing, OSU.

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Tomato Juice

3. Seat #5 Buchner funnel securely into a 2000-ml. filtering flask and attach flask to aspirator pump or other vacuum source. Moisten an 18.5 or 20 cm. "Sharkskin" filter paper with water and spread evenly in funnel.
4. Pour approximately 50-ml. aliquot onto the seated filter paper. Spread sample evenly and thinly on paper. This can be accomplished by carefully pouring sample into center of paper and rotating flask and filter to spread juice to sides. Apply vacuum to filtering flask to remove moisture. Paper should be nearly dry before it is removed from funnel. Repeat this operation with rest of samples and apply rinse water from graduate cylinder to last paper.
5. Remove dry filter paper from flask with aid of tweezers and place on a previously-lined glass or plastic plate. Plate may be lined into 1-inch squares to aid in examination.
6. Using a 100-Watt long wave ultra-violet light source and a binocular wide-field microscope, examine the paper for eggs and larvae. For best results, the light source should be positioned so beam strikes the paper at approximately a 45° angle. Eggs and larvae appear blue-white and may be easily detected.
7. Record number of eggs and larvae separately for each sample.

Tomato Pulp and Paste

3. A 100-ml. aliquot of tomato pulp should be diluted with 200-ml. warm (100°F.) water and 100-ml. tomato paste diluted with 200-ml. of warm water. This aids in the filtering of the sample.

Catsup

3. Dilute catsup with 250-ml. vinegar (40 or 50-grain) or a 4 or 5% acetic acid solution. Stir mixture thoroughly. The acid aids in the removal of the sugar present and thus prevents a haze which would otherwise form.
4. Follow Steps 3-7 as for Juice. (Requires 6 to 8 filter papers).

Unprocessed Tomato Juice

3. Pour only 34 ml. of raw juice onto filter paper at one time. Spread juice evenly, as before. (Requires 3 filter papers.)
4. Follow steps 3-7 as for juice, except use 34 ml. portion of aliquot instead of 50 ml.

RECOMMENDATIONS

1. Sample should be thoroughly mixed before analysis.

2. Aliquot must be spread evenly and thinly over surface of the filter paper in order to prevent some eggs and larvae from being covered with tomato fibers.

3. Best counting results are obtained in a darkened room.

4. After an analyst has become familiar with the counting technique it is possible to use a 10X hand lens instead of the microscope, without loss of accuracy.

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A CHEMICAL STUDY OF FLAVOR AND FLAVOR SUBSTANCES IN TOMATOES

by John Hal Johnson and W. A. Gould

A continuing interest of the Food Technologists at Ohio State University is the improvement of the flavor of processed foods. There are many factors involved in such a complex matter as flavor and doubtless it will take , as it has already taken, considerable research and both time and expense to determine all or even part of the important factors. Presently under consideration are some factors effecting tomato juice flavor.

It is known that variety as well as cultural practices effect the tomato flavor. It is also known that processed juice is different in flavor as compared to fresh juice. Canners hold their juice for a few weeks after processing to allow a bitter flavor to subside. Many questions arise from these and other considerations.

Why is processed juice different in flavor compared to fresh juice? To what is the bitterness due in newly processed juice? What is lost when tomatoes are cooked under atmospheric conditions? Is this loss desirable or undesirable? Does the acid from the juice effect the flavor when it dissolves iron from processing equipment or during storage? One study indicated the build-up of acetaldehyde, a potent off-flavor compound, in processed juice -- why? Is the time that the raw juice is held before heat sterilization important? Are there enzymes present which need immediate inactivation or which would otherwise cause off-flavors? And thus it might be continued.

Past work at O.S.U. on tomato flavor was in the area of acids present in the tomato. Two factors influencing flavor are (1) water soluble compounds and (2) volatile compounds. Both are important since that which smells unsavory is hard to enthuse the appetite with, while that which tastes bad even after an inviting aroma is also non-appetizing.

Previous studies by workers in this laboratory considered some of the non-volatile water solubles on keto, citric and amimo acids of the tomato. Significant differences were observed in the varieties tested. Future work will be to determine some possible decomposition products which may cause flavor variation. As will be suggested below, decomposition products may arise from enzyme activity; metal contamination; and heat, especially heat coupled with dissolved metal.

Recent research on frozen vegetables has related a build-up of acetaldehyde to enzyme residues resulting from under-blanching. In this case the enzyme was peroxidase. The amount of acetaldehyde was related to an undesirable flavor and to the amount of residual enzyme activity.

Past research of volatile materials collected from tomato juice before canning indicated the presence of approximately 33 p.p.m. of carbonyl compounds, mostly acetaldehyde. The canned product had approximately 45 p.p.m. of carbonyls. Further research has indicated that peroxidase in the tomato is found mostly in the skin. Since peroxidase is an acid dissociated enzyme, it is reasonable not to expect any activity in the tomato flesh. However, other enzymes are capable of causing a build-up of acetaldehyde. A most natural suspect is carboxylase which decarboxylates alpha keto acids giving rise to carbonyl compounds and carbon dioxide. Carboxylase has as its co-enzyme thiamine in which the tomato is a rich source, and the enzyme is activated by ferrous ion (Fe^{++}) which of course is also present in abundant supply. Furthermore it is known that pyroic acid is present in tomato juice and while other workers in this laboratory found only 1 - 6 p.p.m. in the various varieties, if enzyme activity decomposed the acid as it was made, a build-up of acetaldehyde would result and the acid concentration would be low. Previous research indicates that in the absence of air acetaldehyde would not be the end product of enzyme activity, but when oxygen is available acetaldehyde is produced in an irreversible reaction.

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Not only can enzymes give rise to decarboxylation and to carbonyls, but iron and other metals are potential offenders. Heat alone is capable of decomposing pyruvic acid but the end products are acetic acid and carbon monoxide.

The bitter constituent of freshly processed tomato juice may be carbonyl compounds. A well known chemical reaction involves carbonyls and amino groups. The carbonyls may subside as a result of this type of reaction. In spite of these promising leads much research is required to prove the theoretical possibilities.

It should also be stated that our prime interest is flavor improvement.

The objectives of our present research include:

1. Detection of possible enzyme systems capable of causing a build-up of carbonyl compounds in tomato juice.
2. Estimation of the amount of iron, if any, picked up during processing and storage of the juice.
3. Obtain information on the possible relation of enzyme activity and iron pick-up.

It is hoped that this research will furnish information leading to greater knowledge of flavor constituents in tomato juice and how they may be related to tomato flavor.

TANNIN CONTENT EFFECTS GRAPE JUICE QUALITY

by D. R. Davis and H. L. Stammer

A large majority of Concord grapes produced in Ohio are sold to commercial grape juice processors. The purchase price is usually determined by the soluble solids content of the fresh grapes with those containing less than 15 percent soluble solids being rejected and those at 18 percent soluble solids bringing a premium price.

Recent tests indicate that tannin, an inherent component of grapes, is as important as the soluble solids in determining the quality of the finished grape juice. Although no definite limits have been established, a tannin content between 0.15 to 0.20 percent apparently is essential for optimum flavor development. Tests have shown that grape juice containing 14 percent soluble solids and 0.16 percent tannins were rated consistently higher than grape juice containing 18 percent soluble solids and 0.10 percent or 0.22 percent tannins.

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pH SURVEY FOR TOMATOES IN OHIO

by W. D. Bash, Extension Specialist in Food Processing

The Ohio pH survey was conducted during the 1959 tomato processing season. Reports had been received by the Horticultural Products Division for some time indicating that certain tomato processing areas were experiencing a gradual rise in pH levels for tomatoes.

The Tip Top, Bryan, and Gypsum Canning Companies made available their facilities for this study. A schedule was established whereby each of these plants would be visited once a week and the pH determined on 100 fruits. The survey started the second week of the season and continued for the next five consecutive weeks. Two plants were missed during the weekly visits, so a total of 13 plant checks were made, with 1300 tomatoes being evaluated.

The procedure for analyzing the tomatoes was the same for each plant. A hamper of tomatoes was selected at random from a grower's load as it was ready to unload at the plant. The variety and the name of the grower was recorded for each sampling. The individual tomatoes were analyzed just as they came from the hamper, with no previous sorting or grading. The tomatoes were first cut in half and the color determined with the aid of an Agtron "E" colorimeter. The juice was then extracted from the individual tomatoes and the pH was determined using a Beckman pocket pH meter. Total acid was determined by titrating the tomato juice with 0.1 N NaOH to a given pH (8.3) on the pH meter. Notations were also made if the tomatoes had any mold or rot present.

The data received from this survey has been summarized in Tables I-IV. Table I is a general summary of all the data obtained. The 1.4 sigma value represents the two extremes between which 84% of the individual tomatoes had pH's for a particular plant check. By comparing the figures in the 1.4 sigma column with those in the range column, spread for pH of the tomatoes can be obtained. If the range figures are much greater, there is an indication that the particular sample had pH values that fluctuated greatly. Table II gives a quality comparison of the sound and unsound fruits as they appeared in the survey.

The day after our survey started, information was obtained indicating that an increase in the pH of tomatoes was evidence of rotten or moldy portions of tomatoes. As is indicated in the table, in every case the pH of the sound fruit is lower that that of the unsound fruit. The relationship of the total acid and Agtron "E" figures may also be correlated in the same manner. The total acid was low in the unsound fruit and the color reading indicated more mature fruits.

The relationship of pH and total acid to the fruit maturity is given in Tables III and IV. The pH and % total acid are listed according to the Agtron "E" color values. The breakdown is as follows: High 1's 0-39; low 1's 40-47; high 2's 48-65; and low 2's 66-84. As is indicated by the grand average, the more mature the fruit the higher the pH and the lower the total acid.

The results of this survey indicate several important things. The pH levels in Ohio are well within the acceptable limits, that is, below pH 4.5, provided the proper sorting and grading procedures are followed. Sorting prior to processing is very important when one considers the high pH values obtained for unsound fruit and for over-ripe fruit.

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Table I - Analysis of Data Obtained in pH Survey of Ohio Processors - Average Values Obtained from 100 Tomatoes per Sampling

CODE	VARIETY	DATE	pH	1.40-*	RANGE	% TOTAL ACID	AGTRON E**
212	Rutgers	8/18/59	4.37	4.01-4.72	4.00-6.10	.453	38.33
312	K.C. 146	8/19/59	4.23	4.03-4.42	3.98-4.73	.594	37.01
123	Rutgers	8/24/59	4.21	3.89-4.52	3.85-5.40	.667	50.89
223	Glamour	8/25/59	4.25	4.13-4.37	4.00-4.45	.503	33.77
134	K.C. 135	8/31/59	4.17	3.99-4.35	3.90-4.62	.513	50.74
234	Rutgers	9/1/59	4.19	4.06-4.32	3.97-4.60	.655	41.31
334	Jubilee	9/2/59	4.12	3.77-4.46	3.80-5.97	.832	49.53
145	Rutgers	9/8/59	4.34	4.16-4.51	4.00-4.80	.377	47.93
245	Garden State	9/9/59	4.26	4.03-4.49	3.95-4.80	.475	44.44
345	K.C. 146	9/11/59	4.39	4.19-4.58	4.00-4.63	.471	46.91
156	Rutgers	9/14/59	4.32	4.07-4.56	3.95-5.05	.471	51.02
256	Rutgers	9/15/59	4.31	4.12-4.49	3.95-4.80	.416	35.17
356	K.C. 146	9/17/59	4.39	4.18-4.60	4.15-4.90	.446	44.00

* 1.40- was calculated as outlined in OAES Research Bulletin 781 - A Study of Some of the Factors Effecting the Grade Relationship of Fresh and Processed Vegetables, by W. A. Gould.

** Agtron E - Lower values indicate better color.

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Table II - Quality Comparison of the Sound and Unsound Fruits Used in the Tomato pH Survey - Average Based on 100 Tomatoes for Each Sampling.

			Total 100 Fruits			Sound Fruit			Rotten or Moldy Fruit			
CODE	VARIETY	DATE	pH	% TOTAL ACID	AGTRON E*	pH	% TOTAL ACID	AGTRON E*	% ROTTEN	pH	% TOTAL ACID	AGTRON E*
212	Rutgers	8/18/59	4.37	.453	38.33	4.31	.467	39.96	17	4.66	.376	31.58
312	K.C. 146	8/19/59	4.23	.594	37.01	4.21	.605	36.74	7	4.43	.448	40.57
123	Rutgers	8/24/59	4.21	.667	50.89	4.14	.697	51.85	18	4.47	.539	40.94
223	Glamour	8/25/59	4.25	.503	33.77	4.24	.515	35.90	21	4.26	.456	25.76
134	K.C. 135	8/31/59	4.17	.513	50.74	4.13	.965	52.92	18	4.33	.393	42.61
234	Rutgers	9/1/59	4.19	.655	41.31	4.18	.664	42.04	7	4.33	.530	34.42
334	Jubilee	9/2/59	4.12	.832	49.53	4.06	.875	50.58	15	4.48	.503	43.00
145	Rutgers	9/8/59	4.34	.377	47.93	4.31	.393	47.13	31	4.41	.337	47.51
245	Garden State	9/9/59	4.26	.475	44.44	4.22	.491	45.97	23	4.38	.434	39.30
345	K.C. 146	9/11/59	4.39	.471	46.91	4.35	.478	47.07	25	4.48	.433	44.56
156	Rutgers	9/14/59	4.32	.471	51.02	4.38	.490	52.39	14	4.56	.336	42.57
256	Rutgers	9/15/59	4.31	.416	35.17	4.28	.430	34.64	12	4.51	.343	40.25
356	K.C. 146	9/17/59	4.39	.446	44.06	4.31	.458	45.55	35	4.52	.421	41.29

* Agtron E - Lower values indicate better color

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Table III - The Average pH Values From Each Plant Sampling According to Agtron "E" Color Values.

	HIGH 1'S 0-39		LOW 1'S 40-47		HIGH 2's 47-65		LOW 2'S 66-84	
VARIETY	NO. OF SAMPLES	pH	NO. OF SAMPLES	pH	NO. OF SAMPLES	pH	NO. OF SAMPLES	pH
Rutgers	47	4.33	18	4.30	15	4.28	2	4.29
	21	4.21	21	4.14	24	4.16	11	4.14
	42	4.14	27	4.19	20	4.18	3	4.05
	23	4.36	18	4.32	22	4.28	4	4.35
	19	4.34	22	4.29	31	4.24	9	4.30
	61	4.29	13	4.27	8	4.32	0	
AVERAGE		4.29		4.25		4.23		4.23
K.C. 146	65	4.23	21	4.20	10	4.17	0	
	25	4.38	19	4.37	22	4.34	4	4.30
	18	4.33	25	4.32	18	4.28	3	4.40
AVERAGE		4.31		4.30		4.26		4.35
Glamour	51	4.25	17	4.26	8	4.23	3	4.17
K.C. 135	15	4.21	25	4.15	25	4.10	13	4.09
Jubilee	14	4.14	26	4.05	33	4.05	11	3.95
Garden State	25	4.24	19	4.18	26	4.22	7	4.25
GRAND AVERAGE		4.27		4.23		4.22		4.21

Table IV - The Average Percent Total Acid From Each Plant Sampling According to Agtron "E" Color Values.

VARIETY	HIGH 1'S 0-39 NO. OF SAMPLES	HIGH 1'S 0-39 % T.A.	LOW 1'S 40-47 NO. OF SAMPLES	LOW 1'S 40-47 % T.A.	HIGH 2'S 48-65 NO. OF SAMPLES	HIGH 2'S 48-65 % T.A.	LOW 2'S 66-84 NO. OF SAMPLES	LOW 2'S 66-84 % T.A.
Rutgers	47	.450	18	.482	15	.503	2	.548
	21	.649	21	.683	24	.696	11	.729
	42	.649	27	.655	20	.685	3	.760
	23	.363	18	.397	22	.417	4	.383
	19	.421	22	.475	31	.521	9	.490
	61	.416	13	.478	8	.439	0	
AVERAGE		.491		.528		.544		.582
K.C. 146	65	.596	21	.612	10	.620	0	
	25	.472	19	.492	22	.473	4	.496
	18	.431	25	.427	18	.524	3	.508
AVERAGE		.500		.510		.539		.502
Glamour	51	.493	17	.534	8	.599	3	.580
K.C. 135	15	.464	25	.494	25	.631	13	.563
Jubilee	14	.742	26	.846	33	.919	11	1.029
Garden State	25	.477	19	.502	26	.484	7	.519
GRAND AVERAGE		.509		.544		.578		.600

FLAVOR STUDIES WITH SAUERKRAUT

by J. R. Geisman, S. S. Verma and W. A. Gould

Since many consumers do not like the sour taste of sauerkraut, this study was initiated to evaluate certain flavoring and spice ingredients for improving the flavor and consumer acceptance of sauerkraut.

Samples of sauerkraut containing 1.0 and 1.5 percent acid as lactic were processed. The following ingredients were also added separately: sucrose, tumeric, sweet pickle spices, smoke flavoring and dill pickle spices. These samples were submitted to a student taste panel for flavor evaluation. Color, pH and total acid were also determined.

The results of the taste panel evaluations indicate that when kraut contains 1.0 percent acid (as lactic) at least 20° Brix sucrose must be added before the sample can be distinguished from a sample without sugar added. When the acid content was 1.5 percent, 25° Brix sucrose must be added to produce a difference that could be detected from the check lot. Panel members that did not like sauerkraut preferred the sweetened product, while those that liked kraut preferred the normal product.

When 100 p.p.m. tumeric was added to sauerkraut containing 1.5 percent acid, the samples could be distinguished from the check lot. However, no distinction could be made for preference between the products. Tumeric produced a bright yellow color in the kraut.

Various dilutions of standard sweet pickle spice were evaluated, but all samples were deemed undesirable by the panel. The same results were obtained with dill pickle spice solution.

When various concentrations (100 - 500 p.p.m.) smoke flavoring were added to kraut containing 1.5 percent acid, only the samples containing 100 p.p.m. were acceptable. The same concentration in kraut containing 1.0 percent acid was highly acceptable and was preferred to the check lot by most of the panel.

Only slight differences were noticed in the pH and total acidity of the products. The samples containing tumeric were yellow colored, otherwise the treatments had little effect on color.

Present studies are being conducted in two phases: (1) laboratory taste panels and (2) consumer panel. Treatments packed for laboratory panel analysis include: 0 to 25° Brix corn syrup at 1.0 and 1.5 percent acid and 0.2 to 1.0 garlic at 1.0 and 1.5 percent acid. Samples containing 1.5 percent acid and 1.5 percent acid 25° Brix sucrose have been processed for distribution to the consumer panel.

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THE EFFECT OF FILL WEIGHT ON DRAINED WEIGHT OF CANNED TOMATOES

by Wade A. Schulte and W. A. Gould

Drained weight is an important attribute which effects the quality of tomatoes. This study was undertaken to determine the effect of fill weight upon the drained weight of canned tomatoes.

Fourteen varieties of tomatoes were individually, hand-packed in #303 cans at five fill weights: 9.0 - 9.5 ounces, 10.0 - 10.5 ounces, 11.0 - 11.5 ounces, 12.0 - 12.5 ounces, and a solid pack in which each container was packed as full as possible without crushing the fruit. A 30 grain calcium chloride salt tablet and juice were added; and the cans were sealed under steam-flow closure. Approximately four months later, the tomatoes were graded according to the procedures set forth in the U. S. Standards for Grades of Canned Tomatoes.

The following table is a general summary of some of the results.

TABLE I - The Effect of Fill Weight on Drained Weight

Fill Weight (oz.)	9.0-9.5	10.0-10.5	11.0-11.5	12.0-12.5	Solid Pack
Drained Weight (oz.)*	8.6	9.4	10.0	10.8	12.3
Difference (oz.)**	-0.65	-0.85	-1.25	-1.45	-
Percentage Decrease**	7.0	8.3	11.1	11.7	-

* The drained weights represent an average of 14 varieties at that specific fill weight.

** 9.25, 10.25, 11.25, and 12.25 were assumed to be the average fill weight in obtaining these calculations.

As shown in Table I, in all samples, the drained weight was lower than its corresponding fill weight. Also, the percentage of weight lost increased as the fill weight increased.

As it is shown in Chart I, the solid pack samples weighed 12.3 ounces for drained weight, or 0.65 ounces more than 11.75, the required drained weight for a top Grade A score.

Tomatoes packed at a fill weight of 12.0 - 12.5 ounces scored a high Grade B for drained weight. Those packed at a fill weight of 11.0 - 11.5 ounces scored a low Grade B for drained weight.

Similarly, those packed at a fill weight of 10.0 - 10.5 ounces scored a high Grade C for drained weight, while those packed a 9.0 - 9.5 ounces scored a low Grade C for drained weight.

In the solid pack samples, 0.65 ounces of tomatoes were given away per can or 5.5 cases of tomatoes per 100 cases of tomatoes. If the cans were filled to a lower specific weight, the remaining portion of the can could be filled with less expensive juice and the tomatoes would not be given away. This would increase the effectiveness and the profits of an operation, provided the added labor cost involved at the filling operation is lower than the amount saved by filling at a specific weight.

The evidence in Chart I indicates that if tomatoes are packed by the methods used in this study, specific drained weights can be expected when the can is cut. On the basis of this study, it would seem that a processor could fill at 12.0 - 12.5 ounces in #303 cans and expect an average drained weight of 10.8 ounces. It would follow then that if the fill weight was 12.5 - 13.0 ounces for #303 cans, one could expect a drained weight of 11.25 (assuming a 12 percent decrease in weight) which is Grade A quality. However, this hypothesis would have to validated by further experimentation on a typical production line.

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A NEW METHOD FOR THE MANUFACTURE OF APPLE SIRUP

by M. P. Baldauf, D. R. Davis and H. L. Stammer

Several years ago a simple procedure for the manufacture of a high quality apple sirup was developed at the Ohio Agricultural Experiment Station. This sirup is basically the concentrated product of a solution of partially neutralized, depectinized, filtered cider and sugar. The fresh cider is first depectinized to prevent jelling after concentration by adding a pectic enzyme. The depectinized juice is partially neutralized by adding calcium hydroxide. The depectinized, partially neutralized juice is filtered, enough sugar is added to increase the soluble solids content to approximately 45%, and the product is evaporated until a 70% sugar content is attained and bottled. This product is an excellent substitute for maple sirup, yet is more versatile than maple sirup since it can be used in cooking recipes calling for apples or apple flavoring.

The apple sirup was given to a consumer taste panel consisting of over 200 persons and over 98% rated the product as excellent or good. They further indicated that if such a product were available on the market at a reasonable price, they would be interested in purchasing and using this product.

Further information relating to the manufacture of apple sirup is contained in Research Circular 88, The Manufacture of Apple Sirup by M. P. Baldauf, The Ohio Agricultural Experiment Station, Wooster, Ohio.

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STUDIES ON COLOR RETENTION IN CANNED R.T.P. CHERRIES

by D. R. Davis and H. L. Stammer

A study has been initiated on methods of increasing color retention in canned R.T.P. cherries. Experimental samples were packed commercially with the cooperation of the Gypsum Canning Company, Port Clinton, Ohio. Samples were packed using three basic treatments: (1) steam flow closure and exhausting for 10 minutes at 205° F., exhaust but no steam flow closure, and steam flow closure but no exhaust; (2) packed with and without a 0.1% concentration of red food coloring; and (3) packed in water and packed in 60° Brix syrup. All samples were analyzed chemically one day after packing and after 3 months storage, and organoleptically after 3 months storage.

Objective color analysis on the samples the day after packing showed that the samples packed in 60° Brix syrup and receiving only the steam flow closure before processing had the better color, regardless of whether the red food coloring was added. After 3 months storage results of objective color analysis showed that the samples packed in water with added coloring and receiving both steam flow closure and exhausting had the redest color. Further, the cherries from this treatment had the highest percentage of acids and the lowest sugar - acid ratio of any of the treatments.

After three months storage the samples were presented to a panel for color grading. When the treatments involving only the water pack samples were compared, those containing added color and receiving steam flow closure plus exhaust and steam flow closure but no exhaust were considered to have the better color, while those samples containing added color and exhausted without steam flow closing were considered the poorest in color.

When the treatments of the syrup pack samples were compared, here again the samples with the added color using steam flow closure and the exhaust were rated as having the better color. Those samples which contained no added color and exhausted with no steam flow closure were rated the lowest in color.

A comparison was made by the panel on all treatments of those samples receiving either the steam flow closure and exhaust, steam flow closure but no exhaust, and exhaust but no steam flow closure. The results indicated that in each variable the samples containing no added color and packed in syrup were rated the highest. In those treatments receiving steam flow closure plus exhaust and steam flow closure but no exhaust, the water pack samples with no added color were the poorest in color. In the samples receiving the exhaust but no steam flow closure the water pack samples with added color were the poorest in color.

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CLUMPING STUDIES IN CANNED BLUEBERRIES

by D. R. Davis and H. L. Stammer

The clumping of blueberries during the canning process has been a problem in the industry for many years. Recent studies have shown that it is caused by the binding together of berries by surface wax or cutin and the affinity for clumping varies between varieties and is increased by increasing the time or temperature of the cook. Further, clumping can be eliminated or greatly lessened by agitating the cans during the cooling period immediately after processing. This study is an attempt to show the effect of (1) the length of cooking time, (2) agitation of the cans during cooking and cooling and (3) preliminary washing of the berries with wetting agents and detergents on the clumping of canned blueberries.

The variety Jersey was used throughout the study. Cooking times of 12 and 15 minutes at 212° F. (in #2 cans) were the processing variables. Processing treatments consisted of (1) cooking and cooling without agitation (control); (2) cooking without agitation, cooling with agitation; (3) cooking with agitation, cooling without agitation, and (4) cooking and cooling with agitation. Pretreatment of the berries included washing in water and washing in water containing small concentrations of a cationic wetting agent, two types of non-ionic wetting agents, and a detergent with an ionic wetting agent.

The results of this study showed that increasing the length of the cook increased the clumping, regardless of the treatment. The samples which were cooked and cooled with agitation were by far the best berries in relation to clumping and other quality indices, although some clumping was observed after a 6 month storage period. The worst clumping occurred in those samples which were cooked and cooled without agitation and those samples which were washed in a detergent. When the berries were washed in hot water (120° F.) containing the cationic wetting agent no clumping occurred, but the product was rated sub-standard because of its poor color. Clumping was a serious problem in all other treatments and the berries were given a low grade score because of this undesirable chacteristic.

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INFRA-RED PEELING STUDIES

I APPLES

by L. Lafferty and W. A. Gould

In order to reduce the large losses (15 - 30%) incurred with the present mechanical apple peelers, a study was initiated to determine the possibility of using infra-red radiation for apple-peeling. It was felt that the high ambient temperature and the low penetration of the infra-red radiation would heat the area immediately beneath the peel, thus causing steam build-up which would loosen the peel.

Four gas-fired infra-red burners 22 inches in length were mounted between two 12 x 12-inch steel plates. The burners were arranged so the radiation was toward the center and would offer the maximum coverage to an apple inserted through an opening in the plates into the chamber formed by the burners. The burners were adjustable so the distance between them could be changed to compensate for the size of the apple and the desired heat (1400 - 2000° F.). The apples were placed on a steel rod and inserted into the heating area for the desired length of time and then removed and immediately sprayed with cold water. This cold water spray reduced the surface cooking and softening effect. Air pressure was used to strip the peel from the fruit after it had been loosened by the infra-red exposure.

Fifteen varieties were studied with exposure times varied from 6 seconds for McIntosh and Franklin varieties to 12 seconds for Jonathan and Stayman varieties.

The data indicated that varietal differences were the main factor in the peeling performance of the apples tested. Storage time had very little effect on the peeling quality.

The product obtained after this type of operation was in excellent condition. The peeling losses were greatly reduced over those for the mechanical peeler. The losses on the varieties used ranged from 2.3 percent for Franklin variety to 3.6 percent for Red Delicious and Ruby varieties.

The following varieties gave satisfactory results when peeled with the infra-red techniques:

1. McIntosh
2. Franklin
3. Cortland
4. Rome
5. Ruby
6. Stayman
7. Jonathan
8. Grimes Golden
9. R. I. Greening
10. Northern Spy
11. Turley
12. Baldwin

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INFRA-RED PEELING STUDIES

II TOMATOES

by W. A. Gould, Richard Leiss and Donall Streets

Employing the same source of infra-red heat used to peel apples, a study was undertaken to determine the value of such a method for peeling tomatoes. Data were gathered for the following: (1) peeling differences between varieties, (2) steam versus infra-red peeling, checking especially the time and ease of peel removal, and (3) to determine if any difference in quality existed in processed tomatoes peeled by steam versus infra-red.

Before this data could be obtained, certain adjustments had to be made on the peeler. In addition to the four-gas fired infra-red burners a movable track with revolving forked spindles was obtained from the Bryan Canning Company, Bryan, Ohio. These forked spindles were later replaced by a brass solid rod on which the tomatoes were placed on a bracket (see drawing). This was done to allow for more of the tomato surface to be directly hit with infra-red heat. Also the vertical angles of the burners were adjusted to insure maximum heat penetration of the skin. Tomato samples were obtained from the variety (10 varieties) evaluation study. Sixty tomatoes of each variety were obtained, graded for color (No. 1's primarily), and divided into two groups of thirty each. After Hydrout coring, the tomatoes were placed alternately through the infra-red peeler or the live steam scalder. Then the peel was immediately hand removed. The tomatoes were then canned under commercial conditions as whole, peeled tomatoes. After a six month storage period the processed tomatoes were graded according to the U. S. Standards for Grades of Peeled Tomatoes (drain weight, wholeness, color and defects).

Conclusions:

1) Skin removal was found to be easier with infra-red peeled tomatoes than with steam peeled. There were no instances when peel removal was more difficult with infra-red than for steam peeled tomatoes.

2) There was no difference in grade of processed tomatoes between infra-red and steam peeled varieties.

3) Times for peeling by infra-red varied from 5 - 17 seconds in comparison to a minimum of 45 seconds for the steam peeling method.

4) There were marked differences between varieties when observing ease of peeling, with the varieties, such as KC 146, peeling much easier with the infra-red peeler than with the live steam peeler.

Further changes are proposed for next year to attempt to blow the peel off following infra-red treatment. The use of a low spray water spray was helpful this past year, but some evidence indicates that this can be improved. Limited data indicate that low colored tomatoes peeled as good as high colored or fully ripened fruit.

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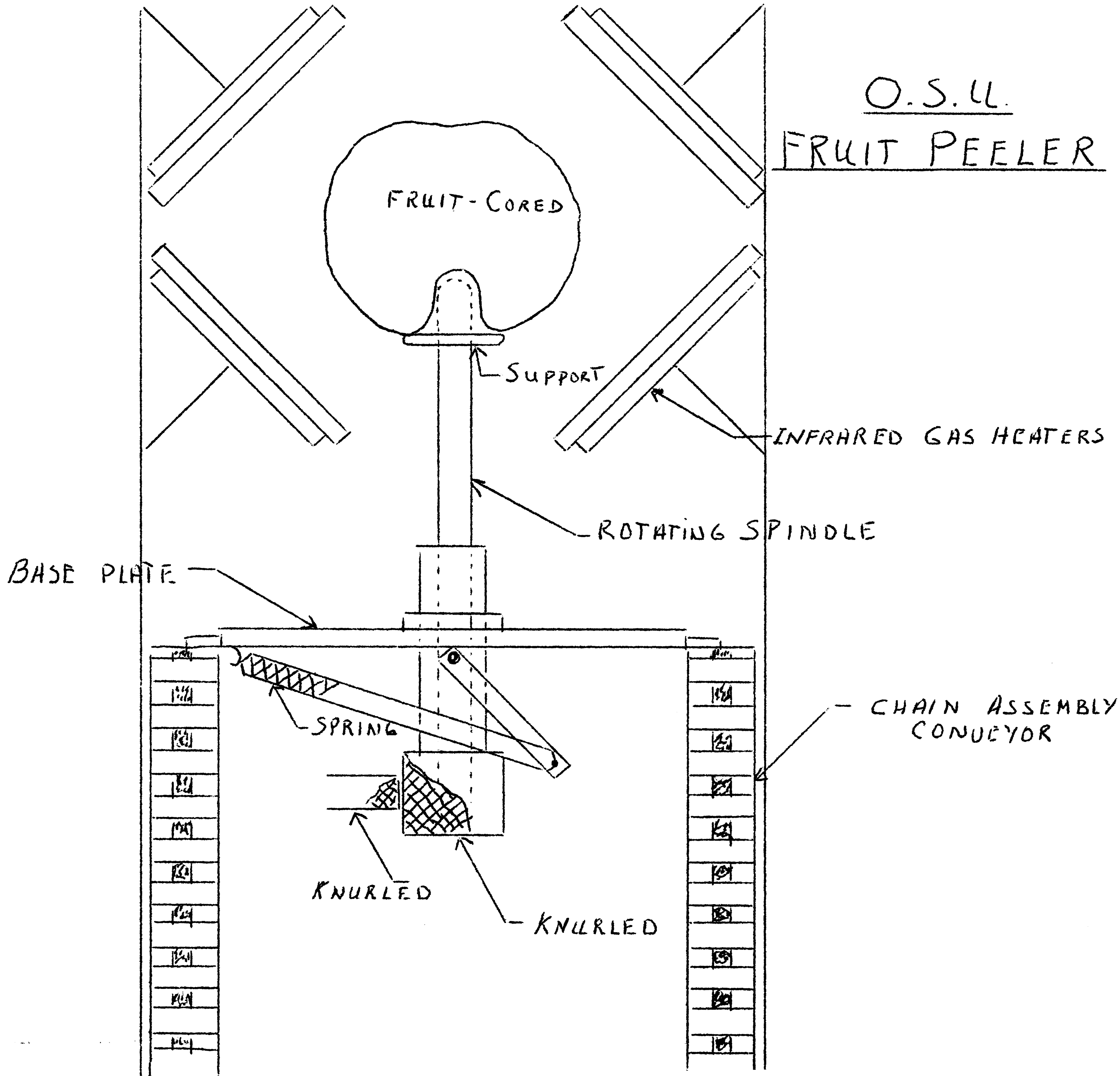
O.S.U.
FRUIT PEELER
FRUIT-CORED
SUPPORT
INFRARED GAS HEATERS
ROTATING SPINDLE
BASE PLATE
SPRING
CHAIN ASSEMBLY
CONVEYOR
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THE EFFECT OF WATER HOLDING TIMES AND TEMPERATURES ON QUALITY OF TOMATOES

by Richard Leiss, Ernest Anderson and W. A. Gould

In an attempt to understand some of the factors concerned with tomato quality and water holding prior to processing, studies were conducted by varying the (1) storage temperatures (45°, 55° and 70° F.); (2) holding times (12 and 24 hours); and (3) chemicals in the holding water (Sorbic acid - 100 p.p.m., Chlorine - 20 p.p.m., Tomato Washing Detergent - 25 p.p.m.).

For this study tomatoes were selected from the variety evaluation study, using six of the standard varieties. The raw tomatoes were graded for color and degree of cracks, both before placing in storage and prior to processing, using the following qualities: No. 1 Quality -- 90% red with no cracks or defects, No. 2 Quality -- 75 to 89% red with no cracks or defects, and No. 3 Quality -- 90% red but every tomato cracked (1" or more in length).

The tomatoes were randomly selected from each of the three qualities and placed in No. 10 cans containing one of the three chemical solutions or plain water which served as a check. The solutions were pre-cooled to one of the three temperatures. The cans of tomatoes, left uncovered, were placed in one of the three temperatures and held for twelve or twenty-four hours. At the end of the storage period they were graded for quality (wholeness, firmness and cracks) and canned using acceptable commercial practices as whole, peeled tomatoes. After six months storage the samples were evaluated according to the U. S. Standards for Grades of Canned Tomatoes (Drained Weight, Wholeness, Color and Absence of Defects). In addition pH and total acid were evaluated for each sample.

From this preliminary study, the following conclusions can be drawn:

1. Tomatoes of No. 3 quality before storage further lost quality (increased size and number of cracks) during storage regardless of variations in holding times, temperatures or chemicals.

2. Tomatoes held at room temperature were found to lose in quality regardless of their quality prior to storage treatment. Little quality change was observed in tomatoes held at 45° or 55° F. storage.

3. Holding times and temperatures appeared to have little or no effect upon quality of the processed tomatoes. As shown in the attached table, the differences in finished product grade are due primarily to the three raw product qualities and not to the holding times or temperatures.

4. Quality variations in the processed tomatoes were found to be primarily due to varietal differences with the firmer fruited varieties withstanding water holding better than some of the softer fruited varieties. However, no definite statement with regards to varieties can be made from this preliminary study.

5. No significant statistical differences existed for the differences in pH between the various treatments other than for the differences inherent in the three raw product qualities.

6. Although not presented in the attached table, the three chemicals added to the holding water prior to storage treatment of the tomatoes all were superior to the check lot in regards appearance of the raw tomatoes. Further, the detergent treated lot and chlorine lot were both better in appearance than the sorbic acid treated lot.

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TABLE I - Relationship Between Quality of Raw Tomatoes and Holding Times and Temperatures On Quality of Canned Tomatoes.

QUALITY	TIME	TEMPERATURE	pH OF CANNED PRODUCT	U.S. GRADE FACTORS: DRAINED WEIGHT	WHOLENESS	COLOR	ABSENCE OF DEFECTS	TOTAL SCORE	GRADE
No. 1	12 hrs.	45° F.	4.23	17	17	26	27	87	B
		55	4.16	16	16	26	27	87	B
		70	4.15	16	16	25	28	87	B
	24	45	4.19	17	17	27	28	89	B
		55	4.26	17	16	27	28	88	B
		70	4.14	16	14	26	28	86	B
No. 2	12	45	4.12	17	16	23	28	86	B
		55	4.34	16	16	23	29	85	B
		70	4.40	17	16	24	27	86	B
	24	45	4.13	17	16	23	27	84	B
		55	4.20	16	15	23	27	82	B
		70	4.23	16	14	23	27	81	B
No. 3	12	45	4.24	16	16	26	27	86	B
		55	4.26	16	15	25	27	85	B
		70	4.23	16	16	26	28	87	B
	24	45	4.28	15	15	25	26	83	B
		55	4.33	16	14	25	26	83	B
		70	4.26	15	13	26	26	81	B

QUALITY ATTRIBUTES OF SWEET POTATOES - GLASS PACKED

by Donald A. Giessler and W. A. Gould, The Ohio State University

This study was undertaken to determine under what conditions sweet potatoes could be successfully packaged in glass containers to render an attractive product free of cloudy syrup and settled solids. Three varieties of sweet potatoes (Unit I Puerto Rico, Goldrush and Can Bake) were prepared for packaging under controlled conditions varying within each variety the degree of rinsing after peeling (light rinse and thorough scrubbing in cold water), the style of pieces (whole, chunk cuts, cross slices and longitudinal slices), and the use of calcium chloride as an additive.

Prior to analyzing the pack, two conditions were varied: first, a representative sample of the pack was subjected to a shipping test; second, the unshipped samples were analyzed for quality attributes on two different dates (after three and one-half months of storage and again after ten months of storage).

The test pack was analyzed for specific quality characteristics, the most pertinent of which were: General Appearance Ratings, clarity of syrup in cylinders after allowing 24 hours for sediment to settle, clarity of syrup in these cylinders after 24 hours to allow settlement of solids and then inverted twice to agitate the solids, and the amount of solids settled in cylinders of syrup after 24 hours. Second in importance were: the weight lost in washing tubers in 250 ml. of tap water plus the solids which settled in this water after 24 hours, and color measurements with an Agtron Model F color meter and a Hunter Color and Color-Difference Meter. The following measurements were made for control purposes: vacuum, net weight, drained weight, volume of package syrup and pH. The following conclusions were based on the results obtained. 1. The shipping test is believed to be necessary for simulating the final condition of the pack as it appears in retail stores. Pack styles with tubers which had been cut into chunks, cross slices or longitudinal slices displayed poorer quality characteristics in the samples subjected to the shipping test than in the samples not subjected to these conditions. In most cases, the packs of uncut tubers were not effected by the shipping test. 2. No significant changes took place during storage of the pack with the exception of color change which was specific for the Can Bake samples. The packed Can Bake and Goldrush samples were orange colored; whereas, the Unit I Puerto Rico samples were yellow colored. The Can Bake samples became more orange with storage time. 3. Cutting the tubers to produce slices or chunks resulted in undesirable turbidity and sediment settle-out in packages. 4. Scrubbing the tubers thoroughly just prior to packing in glass containers significantly reduced syrup turbidity and sediment settle-out in packages. 5. The Can Bake and Goldrush varieties produce a better pack than the Unit I Puerto Rico variety; however, the Unit I Puerto Rico variety may result in a successful pack by using specific preparation treatments and should be chosen if a yellow flesh product is desired rather than an orange flesh product. 6. By thoroughly scrubbing the whole tubers before packing, for all three of the varieties, an attractive package of ready to eat sweet potatoes was attained whether with or without the use of a calcium chloride dip.

A packer contemplating the glass packaging of sweet potatoes should first carefully select the proper variety or varieties of sweet potatoes in accordance with the desired color of the pack and the canning characteristics of the varieties. Secondly, he should follow all precautions to prevent discoloration of peeled tubers including the preheating of tubers prior to peeling and the use of a citric acid dip after peeling. Perhaps most important, the potatoes should not be cut during preparation. This will require the selection of small potatoes for the pack. Also very important in preventing cloudy syrup and sediment settle-out is the thorough scrubbing of peeled potatoes prior to packaging. A quality control program for glass packaged sweet potatoes should include the following: incoming raw product should be examined to assure that the specified variety and size of individual tubers are being received, net weight determinations should be conducted to assure the meeting of label requirements, pH measurements must be made to assure the sufficient acidification of the product necessary for the specified retort processing schedule, initial vacuum of the package after sealing must be maintained at a level sufficiently high to assure lack of excessive internal pressure in the package during retort processing, and samples of the pack should be subjected to a standard agitation condition and analyzed for the development of syrup turbidity and sediment settle-out.

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A STUDY OF SOME OF THE FACTORS EFFECTING THE EFFICIENCY OF WASHING OF FRUITS AND VEGETABLES
I TOMATOES

by W. A. Gould and J. R. Geisman

Insect damage to raw tomatoes for canning is a serious problem since it may be a source of contamination in the finished product. The eggs and larvae of the Drosophila fly represent extraneous matter which may not be present in tomato products. Therefore, there are three phases of Drosophila control which should be well coordinated in order to prevent possible Drosophila contaminations in the finished product. These are field control practices, harvesting and handling practices and in-plant practices. This study was initiated with primary concern to in-plant practices. The objectives were to evaluate the effect of specific types of washers and washing techniques and to determine the value of using wetting agents for the removal of Drosophila eggs and larvae from contaminated tomatoes.

These studies were carried out at the Horticultural Products Division's Pilot Plant, Columbus, Ohio and at a commercial tomato processing plant. The tomatoes were harvested, roughly handled and in some cases held for one to five days before processing. Variations were made in the soak time, temperature of the soak water, type of spray nozzle, height of spray nozzle, number of nozzles, spray pressure, amount of wetting agent and amount of added chlorine. As an index of insect contamination removal, an egg and larva count was made on each lot according to the ultra-violet light (GOSUL) procedure.

These studies have shown that two operations were important for the proper washing of tomatoes. These were soaking and spray-rinsing. Considering the soaking operation, it was found that agitation during soaking aids in the removal of Drosophila eggs and larvae. Agitation may be accomplished in the flume or soak tank by means of air under pressure or live steam. Further, the data indicated that as temperature increased, egg removal was increased and as the time was increased at each temperature, egg removal was increased. However, 140° F. for three minutes seemed to be the upper limit, for at that time temperature period partial scalding of the tomatoes occurred. A significant reduction in eggs and larvae was obtained at 130° F. for three minutes. Therefore, a soaking period of three minutes at 130° F. was recommended.

In the spray rinsing operation, the nozzle which appeared best was the full cone type that gave a square spray pattern. At a height of seven inches above the conveyor one square foot of coverage was obtained. Since impact, coverage, particle size and volume of water used depended on pressure, pressure was probably the most important factor. At 150 p.s.i., waste and water volumes were too large to permit practical application and a pressure of 130 p.s.i. appeared most nearly ideal. At this pressure, the previously mentioned nozzle delivered approximately 6.5 gallons of water per minute and gave the proper impact to accomplish this desired rinsing. Further, it was also found that a roller conveyor was best for this operation, since the tomatoes would revolve while under the sprays and thus permit adequate rinsing of all sides. The tomatoes should make at least two revolutions while under the spray manifold.

In the detergents evaluated, one was found to be highly desirable for washing tomatoes. The greatest reduction in egg and larva counts was obtained at a concentration of 0.25 percent. It should also be pointed out that detergents were not necessary all the time since with some lots of tomatoes, most of the eggs and larvae could be removed by proper soaking and spray rinsing.

In summary, tomatoes for processing should be soaked for three minutes at 120° to 130° F. while being agitated vigorously. A thorough high pressure (130 p.s.i.) spray rinse should follow the soak period. Fresh water should be used for this purpose. A nozzle which gives a square spray pattern at the height of seven inches above the conveyor is recommended. A detergent concentration of 0.25 percent should be used when the raw tomatoes have many cracks and fly activity is heavy. These recommendations should be coordinated with good field control methods and harvesting and handling practices.

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A STUDY OF SOME OF THE FACTORS EFFECTING THE EFFICIENCY OF WASHING FRUITS AND VEGETABLES
II SWEET CORN

by J. R. Geisman and W. A. Gould

Corn earworms and borers present two problems to the sweet corn processor. These are: the insects and their residues. This study was initiated to determine the effect of specific types of washers and washing techniques and the value of certain chemicals and wetting agents for the removal of insect pests and their residues from sweet corn.

In order to adequately control corn earworms and borers, both field and in-plant control measures are necessary. This report is primarily concerned with in-plant procedures. There have been three phases of this work: (1) a screening test of the various chemicals and concentrations (2) a pilot plant study of washing methods in Horticultural Products Division Laboratories at O.S.U., and (3) a commercial application in a sweet corn processing plant.

For the screening and pilot plant tests, sweet corn was grown following acceptable cultural practices on the University Farms, although no pesticides were applied. At the commercial plant, sweet corn was obtained from local growers. The corn was husked and the ears were inspected for earworms and borers. The corn was divided into lots and various treatments were given. After washing and rinsing the ears were thoroughly inspected to determine the number of worms remaining.

The variables studied included: soak time, soak temperature, amount of irritants, amount and type of wetting agent, agitation, type of conveyor, spray pressures, type and number of nozzles and the use of an air blast.

The results of the screening tests indicated that pyrethrins were the best irritants. Further, the use of 0.25 percent of the fruit and vegetable washing detergent produced the desired results of increasing the penetration of the pyrethrin and the removal of insect residues. It was also found that the insects were sensitive to heat and in water at 100° F., they appeared very active. However, when 115° F. was reached, the worms and borers were killed.

From the pilot plant studies, it was found that earworms were not as serious a problem as borers because most of them were removed in the husking operation. Others were removed as the ears were conveyed to the soak tank. Of the few remaining, these were removed by soaking in warm (100° F.) water. On the other hand, corn borers were more difficult to remove. Soaking in warm water had little effect. Irritants were used in order to produce activity of the borers. 83.3 p.p.m. pyrethrins were found to be the best for this purpose. The data indicated that a soaking period of three minutes at 100° F. in water containing 83.3 p.p.m. pyrethrins and 0.25 percent detergent produced the greatest reduction in borers. The ears should be violently agitated during the soak.

Following the soak period, an air blast treatment was investigated. A three minute exposure to the air blast seemed to produce violent irritation in the corn borers and aided in removal.

The purposes of the rinsing operation were two-fold. One was to rinse the insect from the ear, while the other was to remove chemical and insect residues. The nozzles which gave the best result for this operation were of the full cone type giving a square spray pattern combined with knife type nozzles. At 150 p.s.i. the combination produced the greatest removal of insects, residues and corn silk. The data indicated that a roller conveyor should be used. The ears should make at least two revolutions while under the spray manifold.

Studies in the sweet corn processing plant indicated that the above mentioned treatments could be adapted to a commercial operation. On the basis of these results the following recommendations are made for washing sweet corn:

1. Sweet corn for processing should be given a soak of three minutes 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.

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2. The soaking period should be followed by a high pressure (150° F.) spray rinse. The ears should make at least two revolutions while under the sprays. The nozzles should be placed seven inches above the roller conveyor. 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 ears while under the sprays.

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

4. These in-plant practices are merely an aid in packing a quality product free of contamination due to insects. It is highly urged that good production and handling practices precede the factory operations for satisfactory control of insects infesting sweet corn.

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A STUDY OF ALPHA-KETO ACIDS, AMINO ACIDS, AND CITRIC ACID IN EIGHT TOMATO VARIETIES, AND THEIR CHANGES DURING PROCESSING

by Mokhtar M. Hamdy and W. A. Gould, Ohio State University

A preliminary knowledge was sought from this study to estimate the significance of these compounds in evaluating flavor chemically. Alpha-keto acids, a-amino acids and amides, and citric acid were isolated separately from eight tomato varieties before and after being processed. The a-keto acid hydrazones, a-amino acids and amides, and citric acid were isolated and identified by paper chromatography.

Alpha-ketoglutaric acid (KG) was found in all fresh and processed samples in variable amounts. Pyruvic acid (P) was detected invariably in all samples; however, processing was found to break this acid down. A diketo acid was identified in the bishydrazone form as dihydroxytartaric acid (DHTA). Only four varieties were found to contain this diketo acid in the fresh form, while all processed samples did not yield any DHTA.

Fourteen a-amino acids and two amides were identified in most of the fresh and processed tomato-samples chromatograms. Glutamic, glutamine, valine, aspartic, asparagine, alanine, lysine, histidine, serine, threonine, and proline were found in appreciable amounts; on the contrary to glycine, leucine, isoleucine, phenyl alanine, and tyrosine which were found in trace amounts.

The alpha-nitrogenous compounds were determined quantitatively in the form of a-amino nitrogen and glutamic acid. Both glutamic acid and glutamine were found to be the most affected during processing where the latter decreased while the former increased in most cases.

Citric acid was partially destroyed during processing in all samples that were analyzed quantitatively. The actual acidity, determined as the pH, was found to decrease in all processed samples to a rather uniform value of 4.25.

Three ratios were suggested to help in interpreting the chemical analysis data for flavor evaluations. Only the ratios of a-keto-glutaric to citric acid (KG/C) and alpha-amino nitrogen to citric acid (N/C) were reported to be promising for further study.

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