

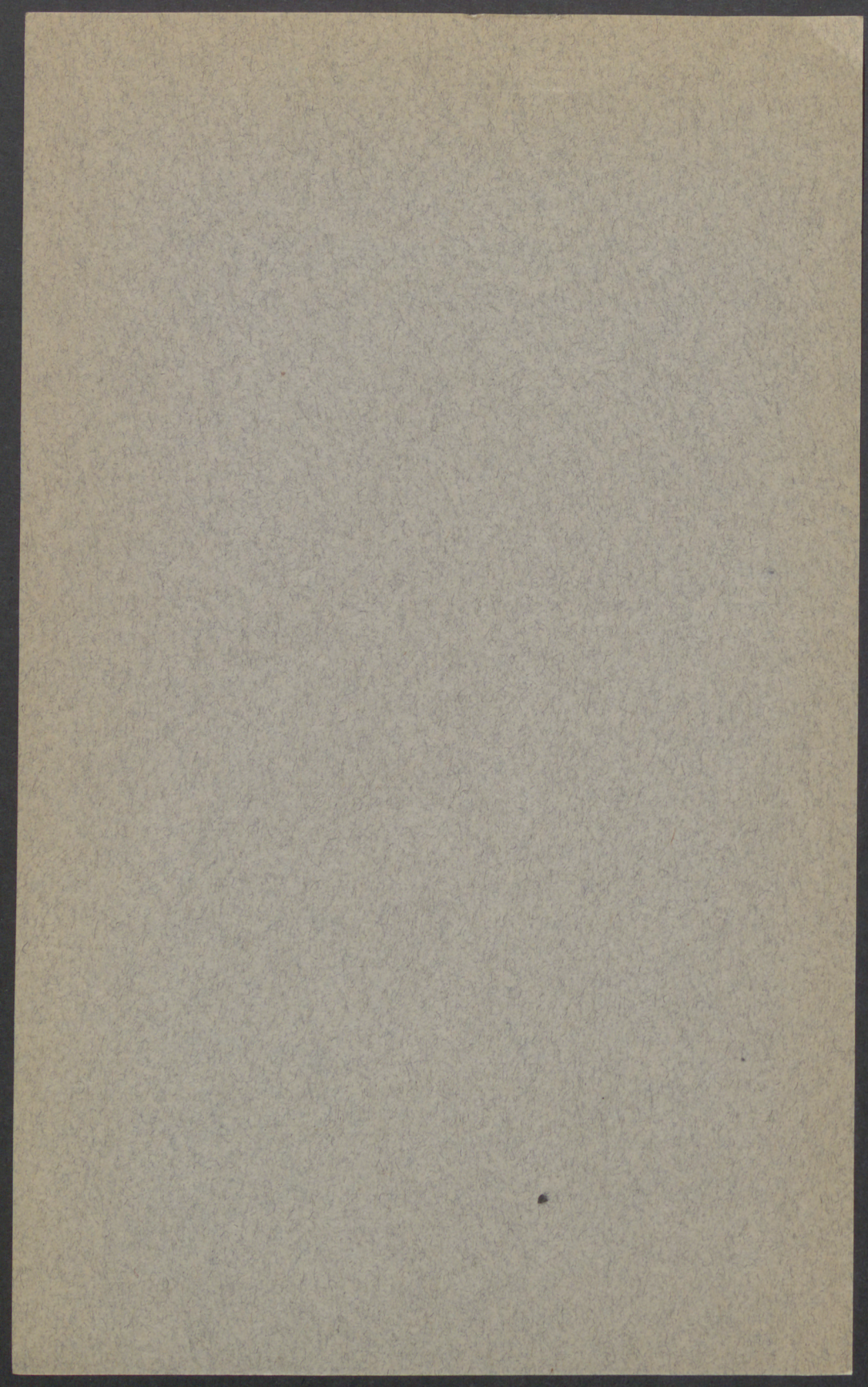
Culinary Quality of Apple Varieties Grown in Minnesota

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Agricultural Experiment Station***

Accepted for publication November 1937.



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ALICE M. CHILD AND RUTH BRAND²

THIS bulletin gives the results of a study of Minnesota varieties of apples to determine their qualities for baking, sauce, pie, and jelly and describes the procedures and techniques employed.

The apples used in this work were known or named varieties and unnamed or numbered varieties from experimental seedling trees, obtained from the University of Minnesota Fruit Breeding Farm at Excelsior, Minnesota, and from commercial growers. A complete list of apples used is given in the appendix. Data on the numbered varieties are not given but are on file.

After picking, the fall apples were kept in cold storage at 34° F. (1.1° C.), and the winter varieties in a storage cellar at 34° to 38° F. until tested. The apples for each series of tests were selected at random from boxes containing the apple variety.

JUDGING APPLE PRODUCTS

The judging of the apple products was done by four experienced judges who used rating sheets for palatability. The ratings were averaged to determine the final score. Sheet A of the rating sheets is used as a guide for scoring and scores are placed on Sheet B. It will be noted on the rating sheets that the first line of each group describes the standard for that factor.

For ease in making comparisons, the numerical ratings of judges are interpreted as "very good," "good," "fair," and "poor." Keys are given in each section to show how this description of qualities was determined.

APPLE JELLY

Preparation of Apple Jelly

Extraction and Clarification of Juice (3 pounds apples)

1. Remove blossom ends of apples and wash.
2. Slice each apple in 1/4-inch slices at right angles to the core. Prepare a sufficient amount for an entire series of tests. Mix thoroughly to obtain a more uniform sample and weigh into pound lots. Hold one pound in reserve for emergency use.

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² The authors are greatly indebted to Prof. W. H. Alderman for supplying fruit from the University of Minnesota Fruit Breeding Farm, to Prof. W. G. Brierley for suggestions and selection of fruit, and to J. D. Winter and Inez Nienow for judging apple products.

3. Place 254 grams of water in first kettle. Place 219 grams of water plus 35 grams of lemon juice in second kettle. Allow liquid to come to a boil and add a pound of apples to each.

4. Cook for 15 minutes at boiling temperature. Upon removal from the flame, add enough boiling water to return each kettle and its contents to the original weight.

5. Empty the hot fruit into a colander covered with cheese cloth.

6. Rock back and forth in the cloth until juice no longer runs freely, and then press out the remainder of the hot juice by twisting the bag.

7. Clarify by pouring it through four layers of cheese cloth (wrung out of hot water) without squeezing it.

For second extractions, weigh the pulp and add an equal quantity, by weight, of water. Substitute 17.5 grams of lemon juice for part of the water in the lot to which lemon juice was originally added. Use the same method for the second extractions as was used for the first.

The method for the preparation of apple jelly is based on Baker's³ method and preliminary work at Minnesota in which methods of cutting the fruit, quantity of water to add, and the effect of adding lemon juice were studied. It was found that the more finely the fruit was cut, the higher the viscosity of the resulting juice. Grinding of fruit gave a poor-colored and cloudy jelly. The preliminary tests showed that it is satisfactory to use a pound of water for each pound of apples in extracting juice.

Tests showed that the addition of lemon juice is a satisfactory method of lowering the pH of the apple extracts to increase their viscosity. The relative viscosity of the extract increases as the original pH is lowered to a critical pH level, characteristic of the individual system, and then drops.

There seems to be a slight advantage in changing the pH while extracting rather than afterward.⁴

Viscosity Determination

Determine viscosity by using a jelly pipette when juice has reached room temperature (approximately two hours).⁵

The time it takes for the juice to flow from an etched mark *A* above the bulb of the pipette to a mark *B* on the capillary tube (Fig. 1) is timed by a stop watch to the nearest half second. This time, divided by the time it takes distilled water to flow between the same marks at the same temperature, gives the relative viscosity of the juice.



FIG. 1.
JELLY PIPETTE

³ Private communication, Baker, G. L., Delaware Experiment Station, Brand, R. H.

⁴ The effect of extraction methods on the relative viscosity of apple juice extracts.

⁵ The method for using pipette and cooking jelly to weight.

The formula for computing relative viscosity is:

$$\frac{\text{Time for juice}}{\text{Time for distilled water}} = \text{relative viscosity}$$

Rinse pipette between tests with warm distilled water, fill with juice to be tested, and discard first filling. Take two readings for each, repeating until two successive readings check within two seconds. The average of the two readings is the reading for that juice.

The Baker jelly pipette (Fig. 1) consists of about four inches of capillary tubing (1 mm. diameter) sealed to a glass bulb of about 2 cc. capacity. The pipette used in this study had a flow period for distilled water of 35 seconds at 24° C.

pH Determination

Using type *K*, Leeds and Northrup potentiometer, determine pH of juice (5 cc.).

Method of Cooking Jelly

1. Weigh juice and sugar into a saucepan, six inches in diameter and six inches deep, and place on a ringstand set on a torsion balance. Add sugar by weight in the proportions determined by using the formula ($\log y = 0.68x + 0.2$). *y* in this formula refers to viscosity, and *x* is the units of sugar. Multiply the weight of juice by this factor.

2. Cook jelly to final predetermined weight, using giant Meeker burner. Final weight is determined by the formula ($\log y = [0.68][6]z + 0.2$). This gives a resulting jelly having 60 per cent sugar. *y* refers to viscosity and *z* is the final units by weight of jelly. Multiply the weight of juice by this factor to determine final weight of jelly.

3. Remove from heat, skim, and pour immediately into sterilized jelly glasses.

4. Cover jelly with thin coating of paraffin immediately. Re-paraffin with a slightly thicker coating the following morning.

5. Store jelly at room temperature in a dark place.

Judging of Apple Jelly

Turn the jelly from the glass on a small white plate. Before cutting it, judge it for clearness and tenderness. Use rating sheet A and place scores on sheet B.

APPLE JELLY RATING SHEET A

FACTOR	QUALITIES	RATING
Texture		
Tenderness	Tender—will quiver, yet is firm enough to hold shape.....	7-8
	Tough—so firm it tends to resist motion.....	4-6
	Soft—tends to run instead of holding shape or	
	Hard—very firm, very tough	0-3
Cutting quality	Knife comes out clean.....	2
	Knife comes out sticky	0-1
Structure	Free from crystals	2
	Crystals	0-1
Flavor		
Intensity	Characteristic apple flavor prominent and distinct.....	4
	Apple flavor desirable but not pronounced.....	3
	Flavor poor, or "off-flavor".....	0-2
Acidity	Pleasingly tart	4
	Slightly too tart, or slightly too sweet.....	3
	Very tart, or very sweet.....	0-2
Color		
Clearness	Clear and sparkling.....	6
	Clear, but no sparkle.....	4-5
	Slightly cloudy	2-3
	Very cloudy	0-1

APPLE JELLY RATING SHEET B

JUDGE _____ DATE _____

JUDGE'S SCORE _____

FACTOR	POSSIBLE SCORE	SAMPLE NUMBERS
Texture		
Tenderness	8	_____
Cutting quality	2	_____
Structure	2	_____
Flavor		
Intensity	4	_____
Acidity	4	_____
Color		
Clearness	6	_____
TOTAL	26	TOTAL _____

Check word which describes jelly as a whole: Very good, Good, Fair, Poor, Average.

Standard Apple Jelly

TEXTURE—Tender—will quiver, yet firm enough to hold shape.
Knife comes out clean when jelly is cut.
Free from crystals of sugar.

FLAVOR— Characteristic apple flavor prominent and distinct,
pleasingly tart.

COLOR— Clear and sparkling.

Table 1 gives a key for the interpretation of the numerical judging scores and of other information concerning the jelly qualities of the apple varieties.

Table 1. Key for the Classification of the Jelly Qualities of Apples

Factor	Very good	Good	Fair	Poor
Rating as pectin source	Juice will carry 1 cup or more sugar per cup of juice	Juice will carry from $\frac{3}{4}$ cup to 1 cup sugar per cup of juice	Juice will carry from $\frac{1}{2}$ to $\frac{3}{4}$ cup of sugar per cup of juice	Juice will <i>not</i> carry $\frac{1}{2}$ cup sugar per cup of juice
Flavor (total score of acidity plus intensity of flavor)	7-8	5-6.9	3-4.9	0-2.9
Rating of jelly (total score)*	24-26	21-23	16-20	0-15

* These divisions of total numerical scores were selected after a group of 54 jellies were judged by four experienced judges who used the numerical rating score and who gave at the same time their opinion of the jellies as they ate them without considering the individual qualities.

Table 2. The pH, Viscosity, Rating of Juice as Pectin Source, the Flavor, and Total Score of Jelly from Apple Varieties Grown in Minnesota in 1935*

Variety	Extraction	pH	Viscosity	Pectin source	Flavor (jelly)	Total score (jelly)
Anisim	1st normal	3.91	3.60	Fair	Good	Fair
	1st acid	3.33	2.70	Poor		
Ben Davis	1st normal	3.91	14.30	Very good	Good	Good
	1st acid	3.37	6.50	Good		
Cortland	1st normal	4.37	4.70	Fair	Very good	Very good
	1st acid	3.60	4.00	Fair		
Fameuse	1st normal	4.26	4.20	Fair	Good	Fair
	1st acid	3.50	4.20	Fair		

* Tested spring of 1936.

Table 2—Continued

Variety	Extraction	pH	Viscosity	Pectin source	Flavor (jelly)	Total score (jelly)
Hawkeye	1st normal					
	1st acid	3.25	4.70	Fair	Very good	Good
Jonathan	1st normal					
	1st acid	3.35	10.20	Very good	Very good	Good
King David	1st normal					
	1st acid	3.08	3.40	Poor	Poor	Poor
Minnehaha	1st normal					
	1st acid	3.40	7.00	Good	Fair	Fair
Perkins	1st normal					
	1st acid	3.40	6.00	Good	Poor	Poor

Table 3. pH, Viscosity, Rating of Juice as Pectin Source, the Flavor, and Total Score of Jelly from Crab Apple Varieties Grown in Minnesota, 1936*

Variety	Extraction	pH	Viscosity	Pectin source	Flavor (jelly)	Total score (jelly)
Dolgo Crab	1st normal	2.99	6.40	Good	Very good	Very good
	2nd normal	3.05	4.20	Fair		
	1st acid	2.89	6.90	Good	Very good	Very good
	2nd acid	2.99	6.10	Good	Very good	Very good
Elsa Crab	1st normal	2.98	6.00	Good	Good	Good
	2nd normal	3.03	2.70	Poor		
	1st acid	2.93	6.20	Good	Poor	Fair
	2nd acid	2.91	2.70	Poor		
Florence Crab	1st normal	3.45	2.20	Poor		
	2nd normal					
	1st acid	3.20	2.50	Poor		
	2nd acid					
Hyslop Crab	1st normal	3.21	5.50	Good	Good	Good
	2nd normal	3.28	2.70	Poor		
	1st acid	3.08	5.00	Fair	Very good	Very good
	2nd acid	2.99	2.90	Poor		
Lyman Prolific Crab	1st normal	3.26	9.20	Very good	Fair	Good
	2nd normal					
	1st acid	3.15	9.40	Very good	Very good	Very good
	2nd acid	3.13	3.00	Poor		
Transcendent Crab	1st normal	3.32	4.10	Fair	Good	Fair
	2nd normal	3.35	2.40	Poor		
	1st acid	3.06	3.80	Fair		
	2nd acid	3.05	2.60	Poor		
Virginia Crab	1st normal	3.40	4.60	Fair	Good	Good
	2nd normal	3.45	3.00	Poor		
	1st acid	3.23	5.20	Good	Very good	Good
	2nd acid	3.18	2.60	Poor		

* Tested fall of 1936.

Table 4. pH, Viscosity, Rating of Juice as Pectin Source, the Flavor, and Total Score of Jelly from Apple Varieties Grown in Minnesota in 1936*

Variety	Extraction	pH	Viscosity	Pectin source	Flavor (jelly)	Total score (jelly)
Cortland	1st normal	3.40	5.10	Good	Good	Good
	2nd normal	3.52	3.50	Poor		
	1st acid	3.11	5.40	Good	Very good	Very good
	2nd acid	2.84	3.60	Poor		
Duchess (Red)	1st normal	3.37	5.12	Good	Good	Good
	2nd normal	3.57	3.19	Poor		
	1st acid	3.01	5.01	Fair	Good	Good
	2nd acid	2.99	3.26	Poor		
Haralson	1st normal	3.40	4.20	Fair	Good	Good
	2nd normal	3.50	3.70	Poor		
	1st acid	3.13	4.60	Fair	Very good	Very good
	2nd acid	3.01	4.20	Fair	Very good	Very good
Jonathan	1st normal	3.62	2.80	Poor		
	2nd normal	3.74	2.90	Poor		
	1st acid	3.23	3.10	Poor		
	2nd acid	3.15	2.80	Poor		
McIntosh	1st normal	3.52	7.80	Very good	Good	Very good
	2nd normal	3.57	3.00	Poor		
	1st acid	3.30	7.80	Very good	Good	Very good
	2nd acid	3.18	2.70	Poor		
Minnehaha	1st normal	3.71	4.00	Fair	Good	Good
	2nd normal	3.79	3.80	Fair		
	1st acid	3.43	4.40	Fair	Very good	Very good
	2nd acid	3.28	4.60	Fair	Good	Good
Northwestern	1st normal	3.45	6.80	Good		
	2nd normal	3.51	4.50	Fair	Fair	Fair
	1st acid	3.23	8.00	Very good	Fair	Fair
	2nd acid	3.13	5.50	Good	Good	Good
Patten	1st normal	3.23	5.10	Good	Good	Good
	2nd normal	3.28	3.30	Poor		
	1st acid	2.99	4.70	Fair	Good	Fair
	2nd acid	2.98	3.10	Poor		
Wealthy	1st normal	3.37	7.10	Good	Very good	Good
	2nd normal	3.28	3.30	Poor		
	1st acid	3.13	7.40	Very good	Very good	Very good
	2nd acid	3.06	4.20	Fair	Good	Good
Wolf River	1st normal	3.33	5.50	Good	Very good	Good
	2nd normal	3.42	2.70	Poor		
	1st acid	3.13	5.80	Good	Very good	Very good
	2nd acid	3.06	2.30	Poor		

* Tested fall of 1936. The jellies were prepared by Inez Nienow.

Discussion of Results

The jelly tests in the spring of 1936 were made on very small quantities of fruit from the fall crop of 1935 that had been held in cold storage. This explains why acid and normal extractions were not run on all varieties.

It is interesting to note that no great differences were found except in the case of the Jonathan apple. The spring tests showed it to be a very good source of pectin, while the fall tests showed it to be a poor source—so poor, in fact, that no jelly could be made from it. This variation may have been due to seasonal conditions, or it may have been due to a change in the pectin constituents of the fruit in storage.

Conclusions

Some apple varieties give better yields of jelly than others because they are better sources of pectin. This study has shown that it is possible to produce a jelly of standard texture from any apple used, if the acidity or pH is controlled and the viscosity known.

The flavor of the jelly made from the different apple varieties is of great importance since the final rating of the jelly, made under controlled conditions, is determined by the flavor. The flavor of most varieties was improved when 35 grams of lemon juice per pound of apples was added to the extraction medium. An improvement is also noted in the rating given jellies made from such extracts.

Jelly value of the apple extracts from most of the varieties was increased when 35 grams of lemon juice was added to the extraction medium. The addition of this amount of lemon juice brought the juice of most of these varieties nearer their optimum pH. With pH controlled, jelly can be made from apples at any season of the year.

APPLE PIE

Preparation of Apple Pie

Pastry

Ingredients	Flour	Lard	Salt	Water
Volume.....	2 cups	½ cup	1½ teaspoons	4-5 tablespoons
Weight in grams.....	226.60	110.00	4.75	59.00

Filling

Ingredients	Apples	Sugar	Salt
Volume.....	1½ quarts	½ cup	½ teaspoon
Weight in grams.....	750.00	100.00	0.50

Prepare crust according to standard method. To glaze the upper crust, apply one tablespoon milk with pastry brush.

Peel apples, cut into ⅜-inch slices, using a sharp slicing knife. Remove core from pieces containing it, cut other pieces in half lengthwise. Use 750 grams of prepared apple slices for a pie 10 inches in diameter and one inch deep. Mix apples, sugar, and salt immediately. Arrange carefully in lined pie plate, pressing down firmly to avoid spaces between slices.

Bake the pies in 425° F. (hot) oven for 45 minutes. Remove from the oven, and place pans on cake racks to cool. Attach identification tag with judging number of pie to each rack.

Judging Apple Pie

Allow pies to cool and judge on the same day as they are baked. Use rating sheet A and record scores on sheet B.

APPLE PIE RATING SHEET A

FACTOR	QUALITIES	RATING
Crust		
Upper	Uniform golden brown. Flaky, not soggy.....	6-10
	Uniform brown. Slightly soggy.....	0-5
Lower	Flaky. Well done. Browned on bottom. Affected only slightly by apple juice.....	8-10
	Flaky. Not brown on bottom. Well done. Slightly soggy.....	5-7
	Not thoroughly cooked. Doughy.....	0-4
Apple Piece		
Color	Clear, translucent yellow.....	18-20
	Any clear uniform color except brown.....	14-17
	Muddy color or brown.....	0-13
Shape	Pieces distinct but soft so that they lie together without spaces between slices.....	8-10
	Slightly soft but too hard to lie together without space between slices.....	5-7
	Pieces that hold their shape only slightly. Pieces that hold their shape too well. Pieces that go to mush.....	0-4
Juiciness	Juice well retained in apple pulp.....	18-20
	Slight dryness of apple pulp.....	14-17
	Dry, woody pulp or excessively juicy.....	0-13
Texture		
Tenderness	Pieces tender and easily cut with fork.....	8-10
	Pieces slightly tough.....	5-7
	Pieces difficult to cut with a fork.....	0-4
Flavor		
Intensity	Characteristic apple flavor prominent, distinct.....	8-10
	Apple flavor desirable but not prominent.....	5-7
	Flavor poor. "Off" flavor.....	0-4
Acidity	Pleasingly acid.....	8-10
	Slightly acid.....	5-7
	Very acid, or flat.....	0-4

APPLE PIE RATING SHEET B

JUDGE _____ DATE _____

VARIETY _____ SAMPLE NO. _____

FACTOR	POSSIBLE SCORE	JUDGE'S SCORE
Crust		
Upper	10	_____
Lower	10	_____
Apple Piece		
Color	20	_____
Shape of apple piece	10	_____
Juiciness	20	_____
Texture—Tenderness	10	_____
Flavor		
Intensity	10	_____
Acidity	10	_____
TOTAL	100	TOTAL _____

Check word which gives your opinion of the pie as a whole: Very good, Good, Fair, Poor.

Table 5 gives an interpretation of the numerical judging scores of the pie qualities of apple varieties.

Table 5. Key for Classification of Pie Qualities of Apples

Factor	Classification			
	Very good	Good	Fair	Poor
Color of apple piece	18-20	15-17	13-14	0-14
Juiciness of apple slice	18-20	15-17	13-14	0-12
Flavor of apple slice	16-20	12-15	8-11	0-7
Rating of apple for pie (score)*	88-100	75-87	48-74	0-47

* These divisions of total numerical scores were decided upon after a group of 64 pies were judged by four experienced judges who used the numerical rating scores and who gave at the same time their opinion of the pie as they ate it, without considering the individual qualities, because they resulted in the closest agreement between the classification of the pie as eaten and when judged on the basis of score.

Standard Apple Pie

UPPER CRUST— Uniform golden brown, flaky, not soggy.

LOWER CRUST— Flaky. Well done. Browned on bottom. Affected only slightly by apple juice.

APPLE PIECE— Color: Clear, translucent yellow.
Shape: Pieces distinct but soft, so that they lie together without spaces between slices.

Juiciness: Juice well retained in the apple pulp.

Tenderness: Pieces tender and easily cut with a fork.

Flavor: Characteristic apple flavor prominent and distinct, pleasingly acid.

Table 6. Rating of Color, Juiciness, and Flavor of Apple Pie Made from Apple Varieties Grown in Minnesota in 1935*

Variety	Color	Juiciness	Flavor	Rating of apple for pie (total score)
Fall and Early Winter Varieties				
Evelyn	Fair	Very good	Good	Fair
Folwell	Poor	Good	Good	Fair
McIntosh	Good	Fair	Fair	Fair
Onondaga	Good	Very good	Good	Good
Patten	Poor	Very good	Very good	Good
Wealthy	Poor	Good	Good	Fair
Wolf River	Fair	Very good	Good	Good
Winter Varieties				
Ben Davis	Poor	Fair	Good	Fair
Black Ben	Poor	Good	Good	Fair
Boiken	Good	Very good	Good	Good
Cortland	Good	Very good	Good	Good
Fameuse	Poor	Very good	Fair	Fair
Haralson	Poor	Very good	Good	Fair
Hawkeye	Good	Very good	Good	Good
Jewell Winter	Fair	Very good	Very good	Very good
Jonathan	Very good	Very good	Very good	Very good
King David	Very good	Very good	Very good	Very good
Macy	Poor	Good	Fair	Fair
Malinda	Fair	Fair	Good	Good
Minnehaha	Good	Very good	Good	Good
Monona	Good	Very good	Good	Good
Northwestern	Good	Very good	Good	Good
Perkins	Good	Very good	Very good	Good
Rockland	Fair	Good	Fair	Fair
Salome	Fair	Good	Good	Fair
Sharon	Very good	Very good	Very good	Very good
Sugar Loaf	Fair	Fair	Good	Fair
Wedge	Very good	Very good	Very good	Very good
Windsor Chief	Very good	Good	Good	Good
Yellow Belleflower	Poor	Good	Very good	Good

* Fruit of medium quality. Tested fall of 1935.

Table 7. Rating of Color, Juiciness, and Flavor of Apple Pie Made from Apple Varieties Grown in Minnesota in 1936*

Variety	Color	Juiciness	Flavor	Rating of apple for pie (total score)
Fall and Early Winter Varieties				
Erickson	Poor	Fair	Fair	Fair
Duchess (Red)	Good	Very good	Very good	Good
Folwell	Poor	Good	Good	Fair
McIntosh	Poor	Good	Good	Good
Patten	Poor	Very good	Fair	Fair
University	Good	Very good	Very good	Good
Wealthy	Good	Very good	Very good	Good
Wolf River	Good	Good	Good	Good

* Fruit of good quality. Tested fall of 1936.

Table 7—Continued

Variety	Color	Juiciness	Flavor	Rating of apple for pie (total score)
Winter Varieties				
Cortland	Good	Very good	Very good	Good
Haralson	Very good	Very good	Very good	Very good
Jonathan	Very good	Very good	Very good	Very good
Minnehaha	Good	Very good	Very good	Good
Northwestern	Very good	Good	Very good	Good
Wedge	Poor	Good	Good	Fair

BAKED OR GLAZED APPLES

Preliminary Investigation

Steam is generated within the apple as it bakes; therefore, some means need to be provided for the escape of the steam so that it does not split the skin unevenly and cause it to fall off. Preliminary tests showed that a slit around the fleshiest part of the apple at right angles to the core was the best method, so this method was adopted for this study.

Considerable work was done to determine if an internal temperature could be set at which an apple could be called "done." At first it seemed that 85° C. could be used for this temperature, but more extensive work showed that it could not be used for all apples, nor could any other one temperature be used, since the state of "doneness" had been reached at various temperatures ranging from 84° C. to 100° C., and the time necessary for reaching this "doneness" varied from 20 to 50 minutes, when all the apples were baked in a 400° F. oven. There seemed to be no correlation between final temperature and time needed to reach that temperature. Some reached high internal temperatures in a short time; others required a longer time but did not reach the high internal temperatures for "doneness." It was evident from this work that no definite temperature would be indicative of "doneness" in a baked apple, and it was also obvious that no definite time could be assigned to the cooking process. Therefore, the method used for deciding when a baked apple was done was to cook until the flesh could easily be pierced with a fork.

Baking or Glazing Apples

Preparation for cooking

1. Wash and core the apples.
2. Make a slit in the skin of each apple at right angles to the core completely around the middle of the apple.

3. Place the apples in a sauce pan $6\frac{7}{8}$ inches in diameter and 4 inches deep if they are to be cooked on top of the stove, or in a baking dish if they are to be baked in the oven.

4. Fill cores with sugar (one gram of sugar per 100 grams of apple).

5. Add $\frac{1}{4}$ cup boiling water for each apple.

Method of cooking

OVEN (method used in 1933 and 1935)

1. Cover baking dish and place in 400° F. oven.

2. Bake apple until tender—usually 30 to 50 minutes. When apple is done the flesh is easily pierced with a fork and there are no hard spots.

TOP OF STOVE (method used in 1936)⁶

1. Cover sauce pan and place over low heat on a medium unit of an electric stove.

2. Cook apple until tender, usually about 10 to 15 minutes, removing cover one minute before removing from the fire and turning apple in the syrup to produce a glaze on the surface.

Judging Baked or Glazed Apples

When judging, place apples and juice in white soup plate. Judge apples the day after baking. Use rating sheet A and record the scores on form given on sheet B.

BAKED OR GLAZED APPLE RATING SHEET A

FACTOR	QUALITIES	RATING	
Color	Outside	Golden yellow with pink blush or red.....	5-6
		Golden yellow without red, or greenish yellow with red.....	3-4
		Greenish, or greenish brown.....	0-2
	Inside	Clear, translucent yellow with pink near the skin.....	5-6
		Any clear, uniform color except brown.....	3-4
		Muddy color, or brown.....	0-2
Shape	Slight cracking of skin, or no cracking, but having the appearance of being soft without flattening of the pulp.....	16-24	
	Spreading cracks in the skin with slight flattening of the pulp	8-15	
	Skin, pulp separation and pulp flattening to mush, or staying too rigid.....	0-7	

⁶ The change to this method in 1936 was justified because extensive preliminary tests showed that apples cooked by this method had a better outside and inside color and had other qualities equal to or superior to those of oven-baked fruit. This method was also a great time saver.

RATING SHEET A—Continued

FACTOR	QUALITIES	RATING
Juiciness	Juice well retained in apple pulp.....	4
	Slight dryness of apple pulp.....	2-3
	Dry, woody apple pulp.....	0-1
Tenderness	Tender—easily cut with spoon.....	4
	Fairly tender—easily cut with spoon, but with some hardness near core.....	2-3
	Tough—hard to cut.....	0-1
Flavor—Pulp Intensity	Characteristic apple flavor prominent and distinct.....	7-8
	Apple flavor desirable but not pronounced.....	4-6
	Flavor poor, or “off-flavor”.....	0-3
Acidity	Pleasingly acid.....	7-8
	Slightly acid.....	4-6
	Very acid, or flat.....	0-3

BAKED OR GLAZED APPLE RATING SHEET B

JUDGE _____ DATE _____

VARIETY _____ JUDGING NO. _____

FACTOR	POSSIBLE SCORE	JUDGE'S SCORE
Color		
Outside	6	_____
Inside	6	_____
Shape	24	_____
Juiciness	4	_____
Tenderness—Pulp	4	_____
Flavor—Pulp		
Intensity	8	_____
Acidity	8	_____
TOTAL	60	TOTAL _____

The apple as a whole was: Very good, Good, Fair, Poor.

Standard Baked or Glazed Apple

- COLOR—** Outside is a golden yellow with pink or red.
 Inside is a clear, translucent yellow.
- SHAPE—** Slight cracking of skin, or no cracking, apple having the appearance of being soft without flattening of the pulp.
- JUICINESS—** Juice well retained in the apple pulp.
- TEXTURE—** Fine grained, smooth and granular—so tender that it may easily be cut with a fork, with a tender skin which may easily be chewed.
- FLAVOR—** It has a characteristic apple flavor, and at the same time is pleasingly acid. The skin flavor should also be desirable.

Table 8. Key Classifying Ratings for Baked or Glazed Apple

Factor	Classification			
	Very good	Good	Fair	Poor
Color	10-12	7-9	5-6	0-4
Shape	20-24	15-19	8-14	0-7
Flavor	14-16	10-13	6-9	0-5
Rating of apple for baking	50-60	40-49	30-39	0-29

Table 9. Rating of Baking Qualities of Apple Varieties Grown in Minnesota, 1935*

Variety	Color	Shape	Flavor	Rating of apples for baking
Fall and Early Winter Varieties				
Folwell	Good	Very good	Good	Good
Hibernal	Fair	Fair	Fair	Fair
Judson	Fair	Fair	Fair	Poor
McIntosh	Fair	Fair	Poor	Poor
Patten	Good	Very good	Good	Good
Wealthy	Good	Good	Good	Good
Wolf River	Fair	Very good	Good	Good
Winter Varieties				
Ben Davis	Fair	Very good	Good	Good
Black Ben	Good	Very good	Good	Good
Boiken	Good	Very good	Fair	Good
Cortland	Very good	Very good	Good	Very good
Fameuse	Fair	Very good	Good	Good
Haralson	Very good	Fair	Good	Fair
Hawkeye	Fair	Very good	Good	Good
Jonathan	Very good	Very good	Good	Good
King David	Very good	Very good	Fair	Good
Malinda	Good	Very good	Poor	Fair
Milwaukee	Good	Very good	Poor	Fair
Minnehaha	Very good	Very good	Good	Good
Northwestern	Good	Very good	Good	Good
Perkins	Fair	Very good	Good	Good
Rockland	Fair	Very good	Good	Good
Salome	Fair	Good	Good	Fair
Sharen	Good	Very good	Fair	Good
Stuart	Poor	Very good	Poor	Poor
Sugar Loaf	Fair	Very good	Poor	Poor
Wedge	Good	Very good	Fair	Fair
Windsor Chief	Good	Very good	Good	Very good
Yellow Belleflower	Good	Very good	Very good	Very good

* 1935 fruit of medium quality. Tested fall of 1935.

Table 10. Rating of Baking Qualities of Apple Varieties Grown in Minnesota, 1936*

Variety	Color	Shape	Flavor	Rating of apples for baking
Fall and Early Winter Varieties				
Erickson	Good	Good	Good	Good
Duchess (Red)	Very good	Very good	Good	Very good
McIntosh	Very good	Good	Good	Good
Patten	Good	Very good	Good	Good
University	Good	Poor	Fair	Fair
Wealthy	Very good	Good	Very good	Very good
Wedge	Good	Very good	Fair	Good
Wolf River	Good	Good	Fair	Good

* Fruit of good quality. Tested fall of 1936.

Table 10—Continued

Variety	Color	Shape	Flavor	Rating of apple for baking
Winter Varieties				
Cortland	Very good	Fair	Good	Good
Haralson	Very good	Very good	Very good	Very good
Jonathan	Very good	Very good	Very good	Very good
Minnchaha	Good	Very good	Fair	Good
Northwestern	Fair	Good	Good	Fair

Table 11. Rating of Baking Qualities of Apple Varieties Grown in Minnesota, 1935*

Variety	Color	Shape	Flavor	Rating of apples for baking
Fall and Early Winter Varieties				
Patten	Very good	Very good	Good	Very good
Wealthy	Very good	Good	Good	Very good
Winter Varieties				
Ben Davis	Good	Very good	Good	Good
Black Ben	Very good	Very good	Fair	Very good
Boiken	Good	Very good	Good	Very good
Fameuse	Good	Very good	Good	Very good
Haralson	Good	Good	Very good	Very good
Jonathan	Very good	Very good	Very good	Very good
King David	Very good	Very good	Good	Very good
Minnchaha	Good	Very good	Good	Very good
Perkins	Good	Very good	Fair	Good
Salome	Good	Very good	Good	Good
Stuart	Poor	Good	Poor	Poor
Sugar Loaf	Poor	Very good	Poor	Poor
Wedge	Good	Poor	Good	Good
Windsor Chief	Fair	Very good	Good	Good
Yellow Belleflower	Good	Very good	Good	Good

* 1935 fruit of medium quality. Tested after January 1, 1936.

APPLE SAUCE

Making Apple Sauce

Preparation for cooking

1. Remove stems, blossom ends, and defects. Wash, dry, and weigh 454 grams (1 lb.) of apples.

2. Slice apples $\frac{1}{4}$ inch thick by measuring with celluloid ruler and making incisions with a long sharp knife. Slice through carefully so that slices are of even thickness. Neither core nor seeds need be removed.

Method of cooking

1. Pour $\frac{1}{4}$ cup boiling water in sauce pan $6\frac{7}{8}$ inches in diameter and 4 inches deep, bring to boil, and add the sliced apples.

2. Cover and cook on preheated medium hot element of electric stove until apple is tender.
3. Force pulp through Foley food mill.
4. Measure 236 grams (1 cup) of apple sauce.
5. Add 14.2 grams (1 tablespoon) granulated sugar.
6. Cook pulp and sugar for 3 minutes in sauce pan. Stir well with wooden spoon while cooking.
7. Pour into enamel cup. Let stand at room temperature until judged.

Judging of Apple Sauce

Just before judging, empty cup of cooled apple sauce into a white soup plate. Judge color and consistency from the plate. Each judge should take a tablespoon of sauce on plate to finish judging. Use rating sheet A and place scores on sheet B.

APPLE SAUCE RATING SHEET A*

FACTOR	QUALITIES	RATING
Consistency	Slightly rounded mass	18-20
	Flows enough to level, slight separation.....	14-17
	Thin and watery, separation of free liquor.....	0-13
Color	Typical uniform bright color throughout.....	18-20
	Slightly lacking in uniformity; dull pink or brown.....	14-17
	Poor color—dull brown or pink	0-13
Finish	Fine-grained and smooth, pulp evenly divided, granular but not lumpy	18-20
	Somewhat pasty, lacks granular characteristics	14-17
	Decidedly pasty or lumpy or coarse	0-13
Flavor	Characteristic apple flavor prominent and distinct	18-20
	Apple flavor desirable but not prominent.....	14-17
	Flavor poor, "off" flavor of overripe or held fruit.....	0-13

* Adapted from rating sheet of Bureau of Economics, U.S.D.A.

APPLE SAUCE RATING SHEET B

JUDGE _____ DATE _____
 VARIETY _____ SAMPLE NO. _____

FACTOR	POSSIBLE SCORE	JUDGE'S SCORE
Consistency	20	_____
Color	20	_____
Finish	20	_____
Flavor	20	_____
TOTAL	80	TOTAL _____

The apple sauce as a whole was: Very good, Good, Fair, Poor.

There are different types of apple sauce. The standard given here is for a strained sauce.

Standard Apple Sauce

- CONSISTENCY— Slightly rounded mass.
- COLOR— Typical, uniform bright color throughout.
- FINISH— Fine-grained and smooth. Pulp evenly divided, granular but not lumpy.
- ABSENCE OF DEFECTS— Practically free from defects, seeds, flecks, bruises, grit, etc.
- FLAVOR— Characteristic apple flavor, prominent and distinct.

Table 12 gives an interpretation of the numerical judging scores of apple varieties for the qualities for sauce-making.

Table 12. Key for Classification of the Qualities of Minnesota Apple Varieties for Sauce-Making*

Factor	Classification			
	Very good	Good	Fair	Poor
Color	18-20	16-17	14-15	0-13
Finish	18-20	16-17	14-15	0-13
Flavor	18-20	16-17	14-15	0-13
	(1936-37)			
Rating of total score	70-80	66-69	60-65	0-59

* These divisions of total numerical scores were decided upon after a group of 64 varieties had been made into sauce. The sauce was judged by four experienced judges, who used the numerical rating scores and who gave at the same time their opinion of the sauce as they ate it without considering the individual qualities, because they resulted in the closest agreement between the classification of the sauce as eaten and when judged on the basis of score.

Table 13. Rating of Qualities for Sauce-Making of Apple Varieties Grown in Minnesota, 1935*

Variety	Color	Finish	Flavor	Rating of apple for sauce
Winter Varieties				
Ben Davis	Poor	Poor	Fair	Fair
Black Ben	Poor	Good	Poor	Poor
Boiken	Fair	Good	Poor	Fair
Fameuse	Poor	Good	Poor	Poor
Haralson	Good	Very good	Very good	Very good
Jonathan	Good	Very good	Very good	Very good
King David	Fair	Fair	Good	Fair
Salome	Very good	Very good	Good	Very good
Stuart	Poor	Poor	Poor	Poor
Sugar Loaf	Poor	Poor	Poor	Poor
Wedge	Good	Good	Good	Very good
Windsor Chief	Good	Very good	Good	Very good
Yellow Belleflower	Good	Fair	Very good	Very good

* 1935 fruit of medium quality. Repeat tests after January 1, 1936.

Table 14. Rating of Qualities for Sauce-Making of Apple Varieties Grown in Minnesota, 1936*

Variety	Color	Finish	Flavor	Rating of apple for sauce
Fall and Early Winter Varieties				
Folwell	Fair	Good	Good	Good
McIntosh	Good	Very good	Good	Very good
Patten	Very good	Very good	Very good	Very good
University	Very good	Good	Fair	Good
Wealthy	Good	Very good	Very good	Very good
Wolf River	Good	Very good	Very good	Very good
Winter Varieties				
Cortland	Good	Good	Good	Fair
Haralson	Very good	Very good	Very good	Very good
Jonathan	Very good	Very good	Very good	Very good
Minnehaha	Fair	Very good	Good	Very good
Northwestern	Fair	Very good	Very good	Very good
Wedge	Fair	Very good	Poor	Good

* 1936 fruit of good quality. Tested fall of 1936.

DISCUSSION OF RESULTS

There was reasonably good agreement in the ratings given the apple varieties from year to year, indicating that seasonal differences do not effect great changes in the ratings given an apple variety for a cooking purpose. It was noted that this agreement was closer if the test dates in different years were comparable. The slight variation noted may have been due to variation in the quality or condition of the fruit. The repeat tests which were run on many of the apple varieties in the winter of 1936 indicated that condition or degree of ripeness of the fruit may change the rating considerably. Fruit, to give reliable tests, should only be used in its best season and when it is fully ripe. The need of further tests to determine the best season for some of the varieties is indicated. In the course of the 1935 tests, when fruit of very good quality and fruit of poor or medium quality of the same variety was tested, it was noted that in many cases the grade of fruit changed the ratings from "fair" or "poor" to "very good." This was true no matter which cooking method was used.

CONCLUSIONS

Careful control of quality and condition of fruit, including degree of ripeness, is necessary if cooking tests are to give a true picture of the qualities of any apple variety.

The general rating of an apple variety for any cooking purpose does not change greatly from year to year. Unquestionably, seasonal growing conditions affect the quality of the apple crop as a whole, resulting in poor seasons in a smaller quantity of good-quality fruit. When fruit is graded by the usual methods of grading and comparable grades are used, the difference in rating for cooking purposes from year to year is small.

Table 15. Average Rating of Minnesota Apple Varieties for Culinary Purposes*

Variety	Pie	Baked	Sauce	Jelly
Fall and Early Winter Varieties				
Erickson	Fair	Good		
Evelyn	Fair		Fair	
Duchess	Good	Very good		Good
Folwell	Fair	Good	Fair	
Hibernal		Fair	Poor	
Judson		Poor	Fair	
McIntosh	Fair	Fair	Fair	Very good
Maud†		Fair	Poor	
Onondaga	Good	Good	Fair	
Patten	Fair	Good	Good	Fair
University	Fair	Fair	Good	
Wealthy	Good	Good	Good	Very good
Wolf River	Good	Good	Very good	Very good
Winter Varieties				
Anisim		Fair	Poor	Fair
Ben Davis	Fair	Fair	Fair	Good
Black Ben	Fair	Good	Fair	
Boiken	Good	Very good	Fair	
Colorado Orange†		Fair	Very good	
Cortland	Good	Good	Fair	Very good
Fameuse	Fair	Fair	Poor	Fair
Golden Russet†		Fair	Poor	
Haralson	Very good	Good	Very good	Very good
Hawkeye	Good	Good	Very good	Very good
Jewell Winter	Very good	Good	Very good	
Jonathan	Very good	Good	Very good	Good
King David	Very good	Good	Good	Good
Maey	Fair		Poor	
Malinda	Good	Poor	Fair	
Milwaukee		Good	Good	
Minnehaha	Good	Good	Good	Very good
Monona	Good	Fair		
Northwestern	Good	Fair	Very good	Fair
Paragon†		Fair	Good	
Perkins	Good	Fair	Fair	Poor
Rockland	Fair	Good	Good	
Salome	Fair	Fair	Fair	
Sharon	Very good	Good	Good	
Stuart		Poor	Poor	
Sugar Loaf	Fair	Poor	Poor	
Wedge	Good	Fair	Good	
Windsor Chief	Good	Good	Good	
Winesap†		Fair	Fair	
Yellow Belleflower	Good	Good	Very good	

* Summary of ratings based on total scores for 1935 and 1936.

† Tested in 1933. Complete data on file.

SEED CAVITY OF MINNESOTA VARIETIES OF APPLES

Apples having a narrow seed cavity are preferred for pie-making by pie factories and others using a coring machine because these machines cut holes about 11/16 of an inch and all the seeds are not taken out if the cavity is wide.

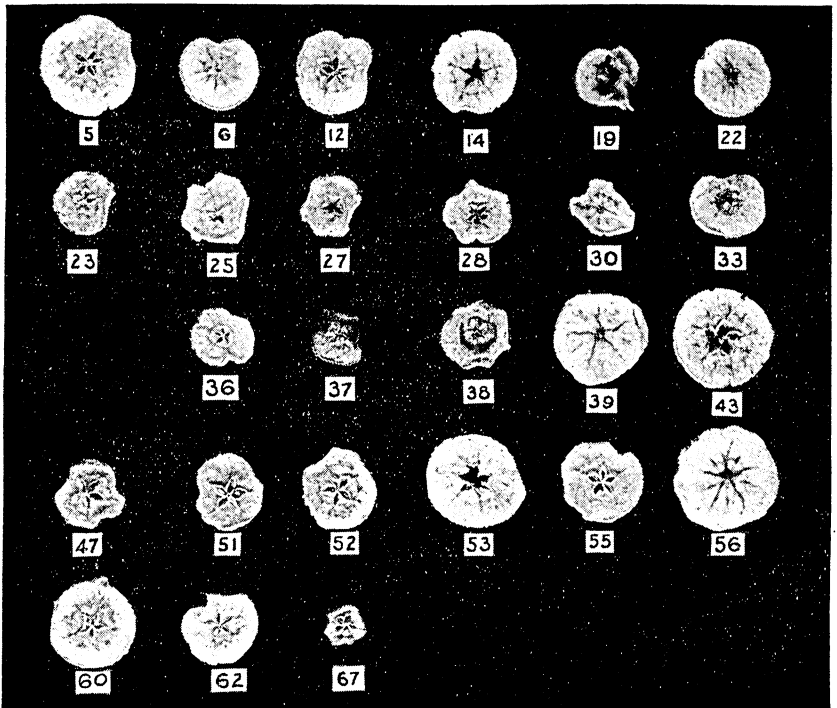


FIG. 2. CROSS SECTIONS OF MINNESOTA VARIETIES OF APPLES SHOWING CORTICAL LAYER, PITH, AND CARPEL

5. McIntosh. 6. Minnehaha. 12. Minn. No. 396. 14. Minn. No. 638. 19. Ben Davis. 22. Cortland. 23. Fameuse. 25. Hawkeye. 27. Jonathan. 28. King David. 30. Malinda. 33. Perkins. 36. Sharon. 37. Stuart. 38. Sugar Loaf. 39. Wedge. 43. Minn. No. 467. 47. Minn. No. 666. 51. Minn. No. 993. 52. Minn. No. 1007. 53. Minn. No. 1008. 55. Minn. No. 1014. 56. Minn. No. 1020. 60. Minn. No. 991. 62. Minn. No. 792.

Figure 2 shows the relative sizes of seed cavities in Minnesota varieties of apples.

Directions for making cross sections of apples for studying relationship of cortical layer, pith, and carpel:⁷

1. Cut cross sections 1/8 to 1/6 inch thick from center of apple.
2. Dehydrate in 70 per cent alcohol 24 hours and in absolute alcohol until completely dehydrated.
3. Cover with cedar oil and allow to stand until clear (12 to 24 hours).

⁷ Adapted from Oregon Agricultural College Experiment Station Bulletin 135, 1916, "Variations of Internal Structure of Apple Varieties," E. J. Krause.

APPENDIX

Apple Varieties Used in These Studies

Table I. Apple Varieties Tested in 1933*

Fall and Early Winter Varieties	Winter Varieties	Winter Varieties—Continued
Folwell	Anisim	Minnehaha
Judson	Ben Davis	Northwestern Greening
McIntosh	Black Ben	Paragon
Maud	Boiken	Perkins
Onondaga	Colorado Orange	Salome
Patten	Cortland	Stuart
University	Fameuse	Sugar Loaf
Wealthy	Golden Russet	Wedge
Wolf River	Haralson	Windsor Chief
Minn. No. 488	Hawkeye	Winesap
Minn. No. 643	Jewell Winter	Minn. No. 790
Minn. No. 658	Jonathan	Minn. No. 876
	King David	Minn. No. 995
	Malinda	Minn. No. 1007
	Milwaukee	

* Obtained from University of Minnesota Fruit Breeding Farm, Excelsior, Minnesota.

Table II. Apples Tested in 1935-36*

Fall and Early Winter Varieties	Winter Varieties	Winter Varieties—Continued
Evelyn	Ben Davis	Sugar Loaf
Folwell	Black Ben	Wedge
Hibernal	Boiken	Windsor Chief
Judson	Cortland	Yellow Belleflower
McIntosh	Fameuse	Minn. No. 700
Onondaga	Haralson	Minn. No. 735
Patten	Hawkeye	Minn. No. 790
Wealthy	Jewell Winter	Minn. No. 792
Wolf River	Jonathan	Minn. No. 821
Minn. No. 367	King David	Minn. No. 838
Minn. No. 396	Macy	Minn. No. 845
Minn. No. 412	Malinda	Minn. No. 848
Minn. No. 447	Milwaukee	Minn. No. 984
Minn. No. 468	Minnehaha	Minn. No. 991
Minn. No. 638	Monona	Minn. No. 993
Minn. No. 643	Northwestern	Minn. No. 995
Minn. No. 644	Perkins	Minn. No. 1007
Minn. No. 657	Rockland	Minn. No. 1008
Minn. No. 658	Salome	Minn. No. 1011
Minn. No. 666	Sharon	Minn. No. 1014
	Stuart	Minn. No. 1020

* Obtained from the University of Minnesota Fruit Breeding Farm, Excelsior, Minn.

Table III. Apples Tested in 1936-37*

Fall Varieties	Fall Varieties—Continued	Winter Varieties
Dolgo Crab	Duchess (Red)	Cortland
Elsa Crab	McIntosh	Haralson
Florence Crab	Patten	Jonathan
Hyslop Crab	University	Minnehaha
Lyman Prolific Crab	Wealthy	Northwestern
Transcendent Crab	Wolf River	
Virginia Crab		

* Obtained from Minnesota commercial orchards.

