Varietal Differences in Cucumbers for Pickling[a,b]

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The suitability of 19 varieties and strains of cucumbers for salt-stock production were evaluated over a 3-year period at a commercial pickling plant. Differences of a magnitude considered commercially important are reported.

The acreage of cucumbers grown for pickle manufacture is fourth largest of the national truck crops grown for processing. About one-half of this crop is produced in Michigan and Wisconsin, one-fifth in the South Atlantic states and the remaining 30% in 16 other states. The wide geographical distribution of the commercial production of cucumbers for pickling has in part been responsible for the development and planting of a number of varieties. Furthermore, the greatly differing nature of pickles manufactured has favored the growing of many different varieties of cucumbers. At present about 20% of the total crop is utilized in the manufacture of "fresh" or "uncured" stock which is packed from the fresh state and is pasteurized in suitable spiced brines or light syrups for preservation. The remaining 80% of the total crop is brined at time of harvest, cured by fermentation, and held until needed for further processing and manufacture into finished pickle products.

The suitability of cucumbers for use in pickle manufacture is greatly influenced by physical and chemical characteristics which may differ decidedly between varieties or even between strains within varieties. Color and shape, characteristics which the commercial pickle maker considers to be highly important, vary widely *(3)*. Similarly, the principal deteriorative changes encountered during brine curing and storage of cucumbers have been reported to be influenced to a considerable degree by variety of cucumber *(3)*.[e] These deteriorative changes, namely softening of salt-stock and development of hollow cucumbers (bloaters), cause serious economic loss annually. The details of softening of salt-stock caused by enzymatic changes and of bloater formation, which is associated with a gaseous fermentation, have been discussed elsewhere *(1, 2, 4, 5)*.

EXPERIMENTAL

The studies reported here were conducted in cooperation with the Brown-Miller Pickle Company at their Texarkana, Texas, plant. The cucumbers tested were grown during the 3-year period 1949 to 1951 at the Fruit and Truck Branch Experiment Station, Hope, Arkansas. All test plots were harvested according to commercial practice. The yields from the different plots were determined according to size and quality grade at each picking. Forty to 50-pound lots of green cucumbers harvested from each plot were separately bagged in coded mesh bags at 2 or 3 picking dates during each season and were brined for salt-stock production. This was accomplished by placing the bags of cucumbers for the given harvest in a large vat otherwise filled with cucumbers of the variety being used at the commercial plant and which were harvested at the same date. The dates selected represented early-, mid-, or late-season pickings. Brining practices employed with vats containing the experimental material were those used by the pickle plant.

Evaluation of the brine-cured stock was made from 4 to 6 months after brining was started. Observations were made which included the following: (a) firmness of the salt-stock as measured by the U. S. Department of Agriculture fruit pressure tester, (b) the length of each sample pressure tested, (c) estimation of bloater formation as shown by inspection of longitudinally cut cucumber samples and (d) the commercial acceptability of the salt-stock as rated by judges who were plant operators.

The salt-stock was evaluated for commercial use by the judges at the time the bagged experimental lots were removed from the vats. The sample lots were then sorted to separate nubby stock. The uniform cucumbers were graded into 3 sizes based on the following diameter ranges: No. 1's, 1″ to 1⅛″; No. 2's, 1⅛″ to 1½″; andNo. 3's, 1⅝″ to 2″.

The No. 1 and 2 salt-stock were used for firmness tests and length measurements and the No. 3 size stock was used to determine bloater formation.

RESULTS

Nineteen varieties and strains were tested for one or more years in this study. Harvest dates of these varieties and strains and seed source for the same are given in Table 1.

A summarization of salt-stock firmness for the years 1949, 1950 and 1951 is shown in Table 2. The firmness values shown represent the means (reported in terms of size No. 1) for 10 brine-cured cucumbers each of the number 1 and 2 sizes representing a total of 20 cucumbers. Testing was accomplished by making a single puncture with the tester at the center of each cucumber. Twelve varieties shown in Table 2 were grown in both the 1950 and 1951 seasons. The values for these 12 varieties represent a 2-year average of firmness for the stock tested.

The averaging of yearly values was done for the following reason: although the absolute value for salt-stock firmness for a given variety differed slightly from year to year the relative firmness of the different varieties tested remained about the same over the period of observation.

Included also in Table 2 are firmness means for varieties grown during one or more of the years 1949, 1950 and 1951 but not during both 1950 and 1951 seasons. All means have been adjusted for comparison to means of 3 pickings in 1950-51. The varietal firmness values in Table 2 have been organized into 3 groups the means of which differ significantly at the 5% level. Differences within each group are not significant.

The bloater formation data are presented in Table 3. Estimation of varietal differences with respect to bloater formation was based on the inspection of approximately 20 No. 3 size fruits per variety for each picking. The cucumbers were cut longitudinally and the extent and nature of bloater formation was noted. Bloater formation has been expressed in terms of percentage of the total number of cucumbers inspected for each variety.

A comparison of length of salt-stock made from different variety cucumbers is given in Table 4. These values are aver-

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[e] See also Circular No. 114, Agr. Exp. Station of the Alabama Polytechnic Institute, entitled "Studies with Pickling Cucumbers in Alabama" by Ware, Isbell, Harris and Johnson. This circular, which has been published since this paper was prepared reports marked varietal differences in suitability of cucumbers for pickling.

ages over 3 pickings in each of 2 years (1950-51). Figures are given for each size class.

The evaluation of salt-stock by judges who were pickle plant operators is summarized in Table 5. The ratings and opinions of the judges were based primarily on the appearance of the different lots of salt-stock. Color, shape and assortment of sizes in the entire sample representing each variety at each picking were the principal factors influencing the judges' decisions. Salt-stock quality as indicated by firmness and bloater percentage was not determined by the plant operator judges and was not known by these judges at the time their evaluation of salt-stock appearance was made.

TABLE 1

Cucumber varieties and strains tested. Seed source, cucumber type and years of production as indicated

Variety name and type [1]		Seed source	Year of test [2]		
			1949	1950	1951
National (LR)	b.s.	L. H. Robinson	X	X	X
National (Asgr.)	b.s.	Associated Seed Growers	X	X	X
National (NK)	b.s.	Northrup King	X	X	X
Davis Blend (LR)	b.s.	L. H. Robinson	X	X	X
Davis Blend (FHW)	b.s.	F. H. Woodruff	X	X	X
Davis Blend (NK)	b.s.	Northrup King	X	X	X
Magnolia	b.s.	Miss. Exp. Sta.	X	X	X
Model	w.s.	Associated Seed Growers	X	X	X
Packer	b.s.	Associated Seed Growers	X	X	X
Mincu	w.s.	L. H. Robinson	X	....	....
Robin 40	w.s.	L. H. Robinson	X	....	....
Snow's Perfection	b.s.	L. H. Robinson	X	....	....
Producer	w.s.	Associated Seed Growers	X	....	X
Earliest of All	w.s.	Burrell	....	X	X
Westerfield	b.s. [3]	Northrup King	....	X	X
New York	w.s. [4]	Associated Seed Growers	....	X	X
Davis Blend (SD)	b.s.	Squire Dingee	....	X	....
Yorkstate	b.s.	L. H. Robinson	....	X	....
Ohio MR-17	b.s.	Associated Seed Growers	....	....	X

[1] Varieties designated as b.s. for black spined and w.s. for white spined types. Capital letters in parentheses following variety represent abbreviation for seed source when variety from more than one source has been tested.

[2] Harvest dates as follows: 1949—June 22, July 4; 1950—June 17, July 3 and 10; 1951—June 27, July 7 and 16.

[3] Also known as Chicago Pickling.

[4] Also known as Brice Special.

TABLE 2

Varietal differences with respect to salt-stock firmness

Group I [1]		Group II [1]		Group III [1]	
Variety	P. T. [2]	Variety	P. T. [2]	Variety	P. T. [2]
Ohio MR-17	17.35 [4]	Davis Blend (NK)	15.80	Producer	14.05 [4]
Model	17.10	Yorkstate	15.75 [4]	Snow's Perf.	14.05 [4]
Packer	16.78	National (NK)	15.38	Robin 40	13.75 [4]
Earliest of All	16.78	Davis Blend (FHW)	15.26	Mincu	12.75 [4]
New York	16.35	National (LR)	15.20		
		Westerfield	15.10		
		National (Asgr.)	14.94		
		Davis Blend (LR)	14.85		
		Davis Blend (SD)	14.53 [4]		
		Magnolia	14.52		
Mean	16.67 [3]	Mean	15.17 [3]	Mean	13.65 [4]

Standard error = 0.282 5% Significant difference = 0.887

[1] Groups differ significantly at 5% level. Differences within groups are not significant. All means are adjusted for comparison to means of three pickings in 1950 and 1951.

[2] Firmness in pounds resistance to 5/16" tip of USDA fruit pressure tester. Values represent means of center readings of 10 cucumbers each of sizes No. 1 and 2 for two years of observation adjusted for reporting as size No. 1.

[3] Means in Groups I and II are those for varieties grown in both 1950 and 1951 (unmarked values) which form the basis of the grouping. Standard error and 5% significant differences for varieties grown in both 1950 and 1951 are 0.282 and 0.887, respectively

[4] Values for varieties grown other than in both 1950 and 1951 but adjusted to these years for comparison. Standard error for these varieties, approximately 0.50.

DISCUSSION

Practical application may be made of the firmness values presented in Table 2. Based on a report made previously *(3)* salt-stock averaging 18 pounds resistance to the pressure tests or better is considered good, that averaging between 14 and 18 good to fair and that yielding an average value of 10 to 14 may be considered only poor to fair. These ranges are intended for application to stock of No. 2 size tested under the conditions outlined in the study reported here.

An adjustment in the firmness values in Table 2 should be made in order that they may be comparable to those of No. 2 stock. Analysis of the Nos. 1 and 2 size cucumbers in this study demonstrates that the size No. 2 fruit is always firmer than size No. 1 fruit in lots considered to be free from enzymatic softening. The difference in the pressure test values between Nos. 1 and 2 size fruits is approximately 1.7 pounds on the pressure tester scale. Therefore, to adjust the values in Table 2 for comparison with size No. 2 fruits it would be necessary to increase the listed values by this difference or 1.7 pounds. Upon making this adjustment it will be seen that all lots of salt-stock observed in the 3 years 1949 to 1951 may be classed either as *good* or *fair to good*. However, those varieties listed in Group III of Table 2 certainly are definitely less firm than those in the other groups and lie only slightly above the value denoting *fair* quality.

The averages in Table 4 represent an attempt to show up differences in shape as indicated by length among the

TABLE 3

Varietal differences in cucumber salt-stock for commercial use. Summary of results on bloater formation [1]

Variety	Bloaters %	Variety	Bloaters %
Group I [2]		Group II [2]	
Packer	1	Producer	12
Model	2	Magnolia	13
Yorkstate	2	National (NK)	14
New York	5	National (LR)	14
Earliest of All	5	Westerfield	14
Davis Blend (FHW)	6		
Davis Blend (LR)	6	Group III [2]	
Davis Blend (SD)	7	National (Asgr.)	29
Davis Blend (NK)	7		
Ohio MR-17	7	Group IV [2]	
		Mincu	48
		Robin 40	74

[1] Bloaters in large sized salt-stock (1 5/8"-2" diam.).

[2] Groups differ significantly at the 5% level. Differences within groups are not significant. All percentage values are adjusted for comparison to means of 3 pickings in 1950 and 1951.

[3] Varieties in this group grown in 1949 only. Percentage values not adjusted for comparison to means of 3 pickings in 1950 and 1951.

TABLE 4

Average length of salt-stock made from different cucumber varieties [1]

Variety	Size		Judges' comments on length where applicable
	No. 1	No. 2	
	Inches	*Inches*	
National (NK)	2.58	3.79	Blunt
Producer	2.69	3.69	Stubby, pecan-shaped
Packer	2.87	3.91	Blunt
National (LR)	2.87	3.97	Blunt
Model	2.94	3.84	Too blocky in shape
Davis Blend (FHW)	3.03	3.97	Blunt
National (Asgr.)	3.04	4.06	Blunt
Davis Blend (LR)	3.11	4.11	Blunt
Westerfield	3.15	4.05	Blunt
Davis Blend (NK)	3.23	4.40	No comment (satisfactory)
Magnolia	3.25	4.29	No comment (satisfactory)
Earliest of All	3.37	4.38	No comment (satisfactory)
Ohio MR-17	3.48	4.80	No comment (satisfactory)
New York	3.80	4.92	Too long

[1] Values are averages of ten cucumbers from each of three pickings from each of the two years 1950 and 1951.

TABLE 5

Varietal differences in cucumber salt-stock for commercial use: summary of judges' evaluation (1949-1951)

Variety and grouping	Percentage of salt-stock ratings by judges as:			Judges' criticisms of less desirable varieties
	Acceptable	Barely Acceptable	Not Acceptable	
I Good				
Davis Blend (NK)	100	0	0	Acceptable at all pickings by all judges.
Yorkstate	100	0	0	
Davis Blend (SD)	100	0	0	
Ohio MR-17	100	0	0	
II Fair				
Earliest of All	90	10	0	Pointed; nubby
Westerfield	90	10	0	Color too light; blunt; nubby.
Packer	80	20	0	Blunt
Davis Blend (FHW)	80	20	0	Color too light; blunt; nubby.
Davis Blend (LR)	70	30	0	Color too light; blunt; nubby.
National (Asgr.)	60	40	0	Color too light; blunt; nubby.
National (NK)	60	40	0	Color too light; blunt; nubby.
Model	50	50	0	Too blocky in shape.
Snow's Perfection	50	50	0	Too blocky in shape.
III Poor				
Magnolia	50	30	20	Irregular shape; pointed, crooked.
National (LR)	50	30	20	Color too light; blunt; nubby.
IV Not acceptable				
Producer	10	50	40	Stubby; pecan-shaped; soft seed cavity.
New York	0	30	70	Color too dark; too long; too pointed.
Mincu	0	0	100	(As for Producer)
Robin 40	0	0	100	Color too dark, slender, skin smooth.

varieties. Judges' comments on length are placed alongside the varieties indicating some agreement that salt-stock measuring approximately 3⅛" to 3½" in the No. 1 size is more desirable for plant use.

A detailed analysis of the length measurements indicate that the differences among varieties behaved consistently over the 2 years and among the several pickings. Observations made but not reported here indicated that the cucumbers get slightly shorter as the season progresses and that the 1950 season produced slightly longer cucumbers than did the 1951 season.

A comparison of Table 2, 3, and 5 involving quality evaluation by distinctly unrelated technics places the different varieties and strains in approximately the same rank order. A striking relationship brought out by this study and repeatedly indicated in the different tables is the decided difference in quality or acceptability for commercial use of the different strains of a single variety. Actually, the range of quality ranking is nearly as large between strains (as represented by different seed sources) of a given variety as between varieties.

It should be recognized that the choice of the variety or strain of pickling cucumber to be grown for, or purchased by, pickle manufacturing plants is influenced by factors other than those affecting salt-stock quality. These other factors, which are obviously very important, include productivity and uses for the green cucumbers other than for brining. Productivity is greatly influenced by plant and fruit resistance to disease and other genetic characteristics. Non-brining use of the crop involves mainly the utilization of portions of the harvests for pasteurized "fresh" pickle packs. As was pointed out earlier, about one-fifth of the pickling cucumber crop is used for such "fresh-pack" products. Consideration of these other factors has not been included in this report. Therefore, it is not possible to point out the most acceptable variety or strain for use by commercial pickle packers. However, a number of conclusions are drawn from this study and are listed below as follows:

(a) Model, Packer, Earliest of All, and Ohio MR-17 [f] are varieties which were found to be most satisfactory for salt-stock production.

(b) The variety Producer was not a good one from the pickle manufacturer's viewpoint because it favored formation of salt-stock which was low in firmness, poor in shape and color, and was rather high in percentage of bloaters formed during curing.

(c) Mincu and Robin 40 per unsuitable for brining due to poor shape, low firmness and high bloater content.

(d) Several strains of the National variety were classified as from fair to poor under the conditions of this test. Cucumber color in these strains was frequently light, the shape was blunt in the larger sizes and bloater formation was excessive.

(e) New York (Brice Special) was unacceptable for salt-stock production because of excessive length and because it was too dark in color.

SUMMARY

An evaluation of the suitability of 19 varieties and strains of cucumbers for salt-stock production during a 3-year period has been made at a commercial pickling plant.

Consistent differences of a magnitude believed to be commercially important were observed in the experimental lots tested for salt-stock firmness and bloater content.

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[f] Ohio MR-17 has been only recently introduced and experience with this variety was more limited than with most of the other varieties or strains tested.

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