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Evaluation of Pickles from Cucumber Plants[1] Treated with 2-Chloroethylphosphonic Acid

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Abstract. Cucumbers from plants of a gynoecious cultivar treated with 0, 240, or 480 ppm 2-chloroethylphosphonic acid (Ethrel)were made into fresh-pack pickles and brine stock and evaluated by experienced judges. Fruit from Ethrel-treated plants were shorter than those from untreated plants. Otherwise there were no significant differences in appearance, flavor, texture, firmness, bloater formation, or acceptability of the processed product.

2-Chloroethylphosphonic acid (Ethrel) has been shown to have profound influence on the sex-expression of monoecious cucumbers (2,3,4,5,6,7,9,10). Plants treated with Ethrel generally have more pistillate and less staminate flowers than untreated plants. Several workers have discussed the feasibility of utilizing Ethrel to advance earliness (3,4,6,10,11) and to increase yields (3,4,6,9,10). Timing of Ethrel treatment in relation to plant size and its effect on date of flowering have also been investigated (3,4,6). However, little or nothing has been reported about the effect of Ethrel treatment on the performance of cucumber fruit in either salt-stock or fresh-pack processing. This investigation was conducted to determine if cucumbers from Ethrel-treated plants are comparable to those from untreated plants, when processed by either a fresh-pack or brining technique.

The gynoecious cultivar 'Explorer' was used in these investigations. Standard cultural practices including a herbicide, DCPA at 8 lb./acre at layby, were employed. Aqueous solutions of 240 or 480 ppm Ethrel were applied to the point of run-off when the plants were at the 4-6 leaf stage. The growing season was generally cool (fall crop) and water stresses were minimized by irrigation. Plots were harvested twice

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weekly for 4 weeks. The fruit used in this study were from the 3rd and 4th harvest dates when the plants were bearing well. The 1st samples were harvested September 24, 22 days after the plants were treated, and the 2nd samples were harvested 5 days later. The fruit were harvested at the research station, transported 70 miles, held overnight in a 55°F room, and processed the following day.

For preparing fresh pack pickles, cucumbers 1 to 1-1/8 inches in diam were hand-washed and packed into barrel-shaped quart jars. A cover liquor (Polish Dill flavor) was added to give a fruit/cover liquor packout ratio of 60/40. The product was capped and pasteurized in a 170°F water bath by holding for 15 min after the internal temperature had reached 165°. The jars were immediately cooled to about 90°F internal temperature and stored at 70-80° in cartons until evaluation 4 months later. Chemical analyses of brines for pH, titratable acidity, and sodium chloride were performed as described by Monroe, et al. (8). The final product contained 2.3% NaCl, 0.6% titratable acidity (calculated as acetic), and was pH 3.9. Triplicate samples were packed for each treatment and each harvest date.

The brine stock was prepared from field run cucumbers ranging from 3/4 to 2 inches in diam. Unwashed cucumbers were freed of adhering blossoms, packed in 1 gal jars, and 25° salometer brine added to give a fruit/brine packout ratio of 65/35. Salt was added during the next 2 days to equalize the brine at 25° salometer in the loosely capped jars. The samples were held at 86°F until the titratable acidity, calculated as lactic, was about 0.6%. They were then held at room temperature (70-80°) and salt added weekly to increase the salometer by 7°/week to a final of 60° salometer; the jar caps were then tightened. Each treatment was packed in duplicate for each harvest date.

The processed pickles were cut longitudinally and examined for bloaters, which were designated as "balloon", "lens", or "honeycomb" type, as illustrated by Monroe, et al. (8). Firmness of the pickles was determined with a USDA Fruit Pressure Tester (Magness) using the procedure of Bell, et al. (1).

A panel composed of 4 experienced judges rated the fresh-pack pickles for appearance, flavor, texture, and suitability. The same panel rated the pickles as to their acceptability for commercial use based on firmness, freedom from bloaters, and external and internal appearance.

One effect of Ethrel treatment on cucumbers has been to shorten fruit as measured by length to diam ratios (L/D) (4,6), and further, the shortening has been somewhat proportioned with concn of Ethrel (4). That same effect was observed in the present study with L/D ratios of 2.82, 2.68, and 2.57 for the untreated, 240 ppm and 480 ppm, respectively. Otherwise, the fruit from Ethrel-treated plants were similar in color and shape to that from untreated plants.

Table 1. Evaluation of fresh-pack pickles prepared from Ethrel-treated cucumbers

Ethrel concn[a]	Taste panel rating[b]				Physical evaluation[c]	
	Appearance	Flavor	Texture	Suitability	Pressure test (lb.)	Commercial acceptability
Control	7.2	6.9	8.5	7.2	16.3	7.0
240 ppm	8.2	6.4	7.9	6.8	16.4	7.5
480 ppm	7.8	6.3	8.7	7.2	15.6	7.3
LSD 5%	2.2	1.9	3.7	1.9	4.3	1.1
CV	4	7	10	7	6	3

[a]Six 1-quart jars of pickles composed each treatment.

[b]Ratings were on a 10-point scale: 1=unacceptable; 10=excellent. Suitability was an overall subjective rating by the taste panel but was not a simple average.

[c]Pressure test values represent averages from 30 cucumbers, 1 to 1-1/8 inches diam range. Commercial acceptability was a subjective evaluation based on degree of bloating, firmness, and external and internal appearance.

The fresh-pack pickles were rated good in appearance, flavor, texture, and acceptability by the taste panel; there were no significant differences between treatments (Table 1). Pressure test readings indicated the product was firm according to the classification system of Bell, et al. (1). The acceptability ratings, based on freedom from bloating, firmness, and both external and internal appearance, were also good (Table 1). Again, there were no differences attributed to Ethrel treatment. Bloaters were not present in the fresh-pack product.

The brined stock was not a high quality product, due to excessive bloating; about 2/3 of the pickles had "balloon", "lens", or "honeycomb" defects. However, no treatment effects were noted on the quality of the brined stock. Much of the fruit was of larger diam than 1-1/2 inches and bloating is more of a problem with larger cucumbers. Firmness of the product was rated "good" on the basis of pressure tests, which averaged 14 to 16 lb. Cucumbers from the 2 Ethrel treatments and the control fermented at similar rates, based on acid production. Chemical analyses of the brines at the time of product evaluation also were similar. Final titratable acidity, calculated as lactic, averaged 0.65 to 0.74% and the pH was 3.2 ±0.1. It must be stressed that brining was performed in gal jars, and that a truer indication of worthiness of Ethrel-treated cucumbers might be obtained by brining in commercial sized tanks.

Literature Cited

1. Bell, T. A., J. L. Etchells, and I. D. Jones. 1955. A method for testing cucumber salt-stock brine for softening activity. ARS, USDA. ARS-72-5, p. 15.
2. Lower, R. L. and C. H. Miller. 1969. Ethrel (2-chloroethanephosphonic acid), a tool for plant hybridizers. *Nature* 222:1072-1073.
3. Lower, R. L. and C. H. Miller, F. H. Baker, and C. L. McCombs. 1970. Effects of 2-chloroethylphosphonic acid treatment at various stages of cucumber development. *HortScience*. 5:433-434.
4. McMurray, A. L. 1969. The effect of 2-chloroethanephosphonic acid on the sex-expression of pickling cucumbers. Master Thesis, N.C. State Univ.
5. McMurray, A. L. and C. H. Miller. 1968. Cucumber sex-expression modified by 2-chloroethanephosphonic acid. *Science* 162:1396-1397.
6. McMurray, A. L. and C. H. Miller. 1969. The effect of 2-chloroethanephosphonic acid (Ethrel) on the sex-expression and yields of *Cucumis sativus*. *J. Amer. Soc. Hort. Sci.* 94(4):400-402.
7. Miller, C. H., R. L. Lower and A. L. McMurray. 1969. Some effects of ethrel (2-chloroethanephosphonic acid) on vegetable crops. *HortScience* 4(3):248-249.
8. Monroe, R. J., J. L. Etchells, J. C. Pacilio, A. F. Borg, D. H. Wallace, M. P. Rogers, L. J. Turney, and E. S. Shoene. 1969. Influence of various acidities and pasteurizing temperatures on the keeping quality of fresh-pack dill pickles. *Food Technol.* 23:71-77.
9. Robinson, R. W., S. Shannon and M. D. De La Guardia. 1968. Regulation of sex-expression in cucumber. *BioScience* 19:141-142.
10. Rudich, J., A. H. Halevy, and N. Kedar. 1969. Increase in femaleness of three cucurbits by treatment with Ethrel, an ethylene releasing compound. *Planta* 86:69-76.
11. Sims, W. L. and B. L. Gledhill. 1969. Ethrel effects on sex-expression and growth development in pickling cucumbers. *Calif. Agr.* 23(2):4-6.