ADVISORY STATEMENT:

The Controlled Fermentation Process Compared With a Salt-Free Method for Preservation and Storage of Pickling Cucumbers[1]

by

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SUMMARY: The method proposed for salt-free preservation and storage of green olives and vegetables, such as pickling cucumbers, resulted in stored cucumber stock judged to be not acceptable as to quality for further use in pickle manufacture. This was primarily the result of poor texture and excessive bloater (hollow stock) damage. In contrast, the comparison treatment--the controlled fermentation process--resulted in firm brine-stock of high quality.

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In 1969, Vaughn et al. proposed a salt-free preservation and storage method, directed primarily for green olives prior to their processing into "ripe" olives. These authors also included other produce such as pickling cucumbers as being suitable for their process.

Over the past few years, questions have been raised by the pickle industry about the merits of salt-free preservation, and the subsequent storage method (cited above), for pickling cucumbers. In March of 1973, we initiated a study to compare the method proposed by Vaughn et al. for preserving cucumbers with our controlled fermentation process (Etchells et al., 1973, 1975a).

PROCEDURE: No. 2 size pickling cucumbers (1 1/4 to 1 1/2 in. diam) were shipped to us by air from Pharr, Texas, and were received in good condition, free of mold and visual handling damage. One lot was packed in 5 gal plastic pails and brined according to our controlled fermentation process (25° sal. treatment), including nitrogen purging and inoculation. A second lot was packed into either 5 gal pails or 1 gal glass jars and covered with the preserving solution, recommended by Vaughn et al. (1969), containing a mixture of lactic and acetic acids (4:3, w:w) diluted to contain 1.2% acid calculated as lactic acid; the cover solution also contained 0.3% sodium benzoate. The pack-out ratio in all cases was 60/40; % cucumbers/brine (w/v).

Plastic covers, furnished with the containers, were fitted tightly on 5 gal pails; regular 6 lug, metal caps, with plastic liners, were used to seal 1 gal jars. Plastic fermentation locks were placed in the covers and caps of the containers to allow for the escape of gas. Samples were taken with sterile syringes through rubber serum stoppers inserted in the metal caps and about midway down the side of the 5 gal containers. For further details on sampling by use of sterile 10 ml syringes, fitted with 20-22 gauge needles, see Etchells et al. (1964).

The cucumbers were examined after 3 months' storage at about 80°F for (a) bloater damage (Etchells et al., 1974; Fleming, et al., 1973); (b) firmness (USDA Fruit Pressure Tester, Magness and Taylor, 1925, according to Bell and Etchells, 1961); and (c) overall appearance. Brines were analyzed for pH, acidity calculated as lactic (Etchells et al., 1964), and reducing sugars (Sumner and Somers, 1944).

REPORT: The preserved and stored, salt-free cucumbers were inferior in firmness and were badly bloated as compared with those from the controlled fermentation (Table 1). The flesh of salt-free stock had a grayish-pink color and the odor of the brine was stale and haylike; not typical of salt-stock cucumbers. All of the salt-free stored cucumbers were rated unacceptable for commercial use. In contrast, the material from the control fermentations resulted in firm, relatively bloater-free brine-stock of high quality.

Samples of the cover liquor were taken periodically from all lots during the fermentation and/or preservation storage period. The final chemical tests after 3 months are given in Table 2. Of the nine salt-free lots, only two appeared not to have undergone an active fermentation. The other seven appeared to have fermented, based on sugar utilization and acid production. These tests confirmed visual observations as to turbidity (cloudiness) of the brines during the storage period. The seven 1 gal jars were observed periodically, and the time visual brine turbidity was first noted was recorded; this varied between 13 and 36 days, with one jar not showing signs of fermentation after 3 months' time.

DISCUSSION: The method proposed for salt-free preservation and storage of green olives and vegetables, such as cucumbers, by Vaughn et al. (1969) resulted in stored cucumbers judged to be not acceptable as to quality for further use. This was primarily because of poor texture and excessive bloater damage. It is not surprising that softening occurred in the absence of salt. It is known that the activity of fungal enzymes which cause softening of cucumbers is progressively suppressed as the salt concentration is increased (Bell and Etchells, 1961). The enzymes are very active in the absence of salt, but are not influenced unfavorably by the pH range resulting from the Vaughn acidification treatment. Also, we cannot overlook the influence of the organic acids alone on the loss of firmness of the cucumbers by the salt-free preservation treatment. This has been reported in detail for pasteurized dill pickles by Bell et al. (1972). The same would probably apply to olives (Etchells et al., 1975b).

Furthermore, it is not surprising that microorganisms grew in the acidified cover solution containing 0.3% sodium benzoate; this amount probably equilibrated with the cucumbers at less than half the original concentration added. We have isolated an actively growing yeast (Schizomycetes species) from benzoated (0.2%), refrigerated dill pickle products (Etchells, Bell and Borg (unpublished), that could grow under laboratory conditions in acidified cucumber juice broth plus 3% salt at 0.6% sodium benzoate! Microorganisms vary in their basic tolerance and adaptation to sodium benzoate as well as other preservatives, such as potassium sorbate (Bell et al., 1959). Our experience has shown that continued use of a given chemical preservative, particularly in a careless manner, eventually may result in the development of a microflora that becomes resistant to the chemical.

Storing cucumbers in salt-free, acidified solutions has been tested by Shoup et al. (1975). Although their levels of acidification were greater than those reported by Vaughn et al. (1969), a significant amount of bloater damage still occurred. They stated that the brines were clear, and assumed to be free of microbial activity; we suspect that yeasts may have been present. High production of CO_2 by relatively low yeast counts, plus that from the cucumber itself, can result in serious bloater damage before there is a sufficient number of cells to cloud the brine. Also, bloater damage can occur when the brine solution is less than saturated with CO_2 (Fleming et al., 1973).