Cucumber Blossoms In Salt Stock Mean

SOFT PICKLES

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Reprinted From:

RESEARCH AND FARMING
Vol. XIII, Progress Reports
Nos. 1, 2, 3, and 4, pp. 14-15, 1954-1955

Published by the
AGRICULTURAL EXPERIMENT STATION
NORTH CAROLINA STATE COLLEGE
RALEIGH, NORTH CAROLINA

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SOFT CUCUMBERS cause commercial cucumber pickle packers to suffer a loss of more than $1 million each year. The loss results from the softening of cucumbers during the brine curing and storage of this crop.

This is not a new problem. The homemaker ran into it long ago when she carried out her brine curing and storage in crocks or barrels. Many a commercial salter or homemaker has, however, strongly believed it possible to prevent softening by following "a proper salting schedule" during the curing and storage of cucumbers for pickle manufacture. But the problem that has persisted for so long is still prevalent and it is apparent that this belief is not well founded.

Research Team at Work

Several years ago a research team composed of chemists and bacteriologists of the N. C. Agricultural Experiment Station and the U. S. Department of Agriculture undertook a project to solve the problem of cucumber spoilage in commercial pickle manufacture.

Intensive studies were conducted relative to the chemical and bacteriological changes which occur during the various steps of pickle manufacture, with particular emphasis on the changes which take place during the brining and brine storage operations. The evidence gathered in these studies was conclusive that the softening of cucumbers during brine curing and storage could not be prevented with certainty by the use of any known brining schedule.

Looked at Fruit Changes

The research team then undertook a study of changes which occur within the cucumber fruits as a result of the softening of the cucumbers. It was shown that the tissues of salt stock (cucumbers from brine) were made up mainly of pectic and cellulostic components, and that the texture of the brined cucumber could be changed as a result of the activity of pectin-splitting enzymes on such tissues. Also, this texture deterioration as the result of pectin-splitting enzyme activity could be brought about in the brines under conditions typical of commercial pickle manufacturing operations.

If pectin-splitting enzymes were responsible for salt stock softening, then the problem was to determine the source of these naturally occuring pectin-splitting enzymes. An analysis of the cucumber fruit itself indicated that cucumbers, especially as they approached maturity, often were a source of pectin-splitting enzymes. However, from the evidence at hand it was apparent that there must be other sources of these enzymes if the intensity of pectin-splitting activity which was demonstratable in commercial cucumber brine was to be accounted for.

About the time these findings were made it was observed that the softening of salt stock was much more severe in those vats which were put down at the beginning of the cucumber harvesting period. Also, quite by accident, the observation was made that salt stock from early harvested cucumbers contained about five times as many cucumber blossoms as did similar salt stock from the late harvested crop.

Field and salting-station counts of blossoms retained by cucumbers of different sizes were made. These counts indicated that the retention of blossoms by cucumbers harvested during the first three weeks of the harvest period was much greater than such retention during the last three weeks of the harvest period. In fact, the order of retention was from five to eight times as great during the early as during the latter portion of the season.

Blossoms Contain Enzymes

Laboratory studies showed that blossoms, either fresh or withered, as removed from cu-

* Based on a talk entitled "Studies on the Origin of Pectinolytic and Cellulolytic Enzymes in Commercial Cucumber Fermentations" presented at the Institute of Food Technologists annual meeting, Los Angeles, Calif., 1954. Abstract of this research published in *Food Technology*, Vol. 9: p. 14, 1955.

On the left is a staminate (male) flower which normally would not get into the brine. Next is a pistilate (female) flower bud on a small fruit. Second from the right is an open pistilate flower on a small cucumber. On the right is a withered pistilate flower sticking to a small pickling size cucumber.

cumbers at harvest, were a potent source of great pectin-splitting activity. By these studies it was also proven that such pectin-splitting activity could take place under conditions typical of cucumber brining operations. It appeared then that the large number of blossoms retained on the fruit during the early portion of the cucumber harvest was responsible for salt stock softening during the curing and storage period.

Commercial Packers Cooperated

Tests were set up, in cooperation with commercial pickling plants in North Carolina and other Southern states, to determine the effect of the presence of known quantities of cucumber blossoms in brine during the curing and storage process.

These tests showed that by the removal of all blossoms from the cucumbers, even during the early portion of the harvest period, firm salt stock could be obtained. They also demonstrated that upon the addition of cucumber blossoms to cucumbers from which the blossoms had been removed softening could be artificially induced. The quantity of blossoms added was equivalent to from 50 to 100 per cent retention of the bloom.

Considerable progress has been made toward the solution of the problem, yet there is still much to be done. The fundamental studies which have been made need to be translated into practical application.

Several different approaches can be made to this end, such as: (1) mechanical removal of blossoms from the green stock; (2) inactivation of the softening enzymes by specific, non-toxic compounds; (3) development of improved varieties, through breeding studies, that have a minimum of blossom retention; and (4) development of a draining procedure to reduce the softening enzyme load in brined cucumbers.

Of these possibilities, so far the most progress has been made in the draining procedure. It has been shown that if the original brine is drained off the cucumbers 36 hours after filling experimental vats, the softening enzyme content is drastically reduced and the cured salt-stock is firm. A large-scale experiment on 20 commercial vats (500 bu. capacity) has demonstrated that the cured material from drained lots had twice the firmness rating as that from the regular plant procedure which was not drained.

Special Equipment Needed

At present the pickle industry does not have the special mechanical equipment required to remove the blossoms from the green cucumbers before they are brined. However, many companies are making an effort at least to eliminate the loose blossoms by making certain changes in their grading machines.

Breeding Studies Can Help

The pickle industry has been made fully aware of the important part that breeding studies may contribute to solving the blossom retention problem. They are sponsoring research work to obtain information on factors contributing to blossom retention, and have started breeding programs aimed at obtaining acceptable pickling lines that have a minimum of flowers retained.

The development and use of methods employing specific non-toxic chemical compounds that

would inactivate pectin-splitting and possibly other enzymes responsible for the salt-stock softening is an approach that leads to a highly desirable ultimate objective of the research program. But for the present the draining procedure seems to be the most promising means at hand to avoid softening spoilage losses. Also, an improvement in the handling procedures of commercial pickling plants in the brining operations seems in order, to prevent the addition of cucumber blossoms during the brining operation.