BAG-IN-BOX TECHNOLOGY:
Preservation of Brined Vegetables Without Fermentation

R. F. McFeeters*, H. P. Fleming, O. O. Fasina, and L. M. Papageorge

U. S. Department of Agriculture, Agricultural Research Service,
and North Carolina Agricultural Research Service,
NC State University, Raleigh, NC 27695-7624, USA

ABSTRACT

Acidification has been used in a variety of ways to safely preserve vegetables. The approach that we are taking is to systematically investigate the capabilities of traditionally used acids and preservatives to prevent growth of spoilage organisms and to kill acid-tolerant pathogens. We want to provide new opportunities to develop 'process-ready' vegetable ingredients for further processing. This is an update on the use of this approach for cucumbers and peppers. Cucumbers have been preserved on a pilot scale using the bag-in-box approach. However, we have some significant problems to overcome in making final products from the stored cucumbers. The work with peppers have given us new insight into how they soften and has led to the unexpected finding that sulfite helps to maintain the firmness of some peppers.

INTRODUCTION

Cucumbers and cabbage are unusual in that they are commonly fermented for bulk storage prior to further processing. Other vegetables, such as peppers and cauliflower, are brined in high salt concentrations to prevent fermentation during storage. There is very little published information on the best procedures for doing this type of vegetable storage. Historically, companies have developed in-house procedures that can be quite variable across the industry. This approach to brining typically results in a high salt, high biological oxygen demand (BOD) brine that must be disposed of in some way. Depending on the proportion of the brined ingredient used in a final product, it may be necessary to do a processing step to remove salt. This creates another higher volume waste stream with lower salt and BOD levels.

We have been investigating procedures to do bulk storage of cucumbers and peppers with brining conditions that will result in 'process-ready' vegetables, meaning they would be ready for use as an ingredient in institutional or retail products without further processing. Doing this will gain the same advantages of bulk storage for non-fermented vegetables that would result for fermented cucumbers. It will provide a reliable ingredient supply to the processor, and, since brining will be done with no salt or only that salt needed in the final product, smaller amounts of non-degradable salt would require disposal.

Vegetables such as pepperoncini peppers or small pickles from India are being preserved in bulk and shipped without fermentation. The pepperoncini peppers are low in acid, but are shipped with about 11% salt and 400-800 ppm sulfite, so they require washing out of salt and sulfite before being used in a final product. The small pickles from India contain 3-4% acetic acid, 4-8% salt, and up to 120 ppm sulfite, so brine ingredients must also be removed from this product. Our intent is to add no salt and keep the acid and preservative levels sufficiently low so that a washing step with the consequent high salt, high BOD waste stream would not be generated.

To develop long-term bulk storage with this concept, two major goals have to be realized. **First**, it is necessary to find combinations of the appropriate acids, acid concentration, equilibrated pH, and food-grade preservative(s) to assure that no microorganisms will grow during storage, and that acid-resistant pathogenic bacteria will rapidly die. **Secondly**, good texture, flavor, and color characteristics must be maintained during storage and any subsequent processing that might be done. Both goals are critical to success, but the goal of good quality with the different vegetables that might be preserved will undoubtedly take more time and effort than preventing growth of microorganisms. Our expectation is that the conditions that prevent microorganisms from growing in cucumbers will probably prevent organisms from growing in other commodities. However, important quality issues are often unique to a particular vegetable, so it is unlikely that one approach to assuring good retention of texture, flavor, and color will be successful across commodities.

We are working on this storage concept for cucumbers and peppers. In the case of peppers, our primary work has been on red bell peppers, with some more limited experiments with green bell peppers, jalapeno peppers, and banana peppers. Discussions with people who have brined peppers indicated that red peppers were very susceptible to softening problems. So the concept in concentrating on them was that if conditions could be found for successful extended storage of red peppers, those same procedures, perhaps simplified, would likely work for other types of peppers.

Cucumber Preservation

The initial impetus for pursing non-fermentation storage of vegetables was the idea that it might be feasible to preserve with a reasonably low levels of acid, use sulfite to prevent growth of microorganisms, and then remove sulfite at the end of storage by its reaction with food-grade hydrogen peroxide. Figure 1 shows that we were able to accomplish preservation of cucumbers with sulfite using only hydrochloric acid (Fleming et al., 2002c)[1] to lower the pH. It was also possible to remove sulfite to the point that it was not detectable (<3 ppm) by addition of hydrogen peroxide (McFeeters, 1998).

Bag-in-Box Non-Fermentation Storage

We used the pilot scale equipment described by Fleming et al. (2002a) to test the preservation of cucumbers in 250-300 gal bags. The process that has been successful in preserving cucumbers for 6 weeks (we have not attempted to hold them longer), as shown in Figure 2. Cucumbers (sizes 2B and 3A) were washed, but not blanched prior to putting them in a bag. No attempt was made to maintain aseptic conditions during transfer to the bag because the acid and sulfite in the brine were expected to kill the vegetative cells of the organisms naturally present on the green stock. A cover solution was added to give a pack-out ratio of either 50:50 or 55:45, and to

[1]Hydrochloric acid is a GRAS ingredient in the United States, and it is listed in the Codex Alimentarius. However, it may not be approved for use in all countries, Canada for example. Use of concentrated hydrochloric acid requires specific safety precautions. Consult your supplier.

Pickle Pak

SCIENCE

Published by

Pickle Packers International, Inc.
Box 606
St. Charles, IL 60174 U.S.A.

November 2002
Vol. VIII — No. 1

ABOUT THE COVER:

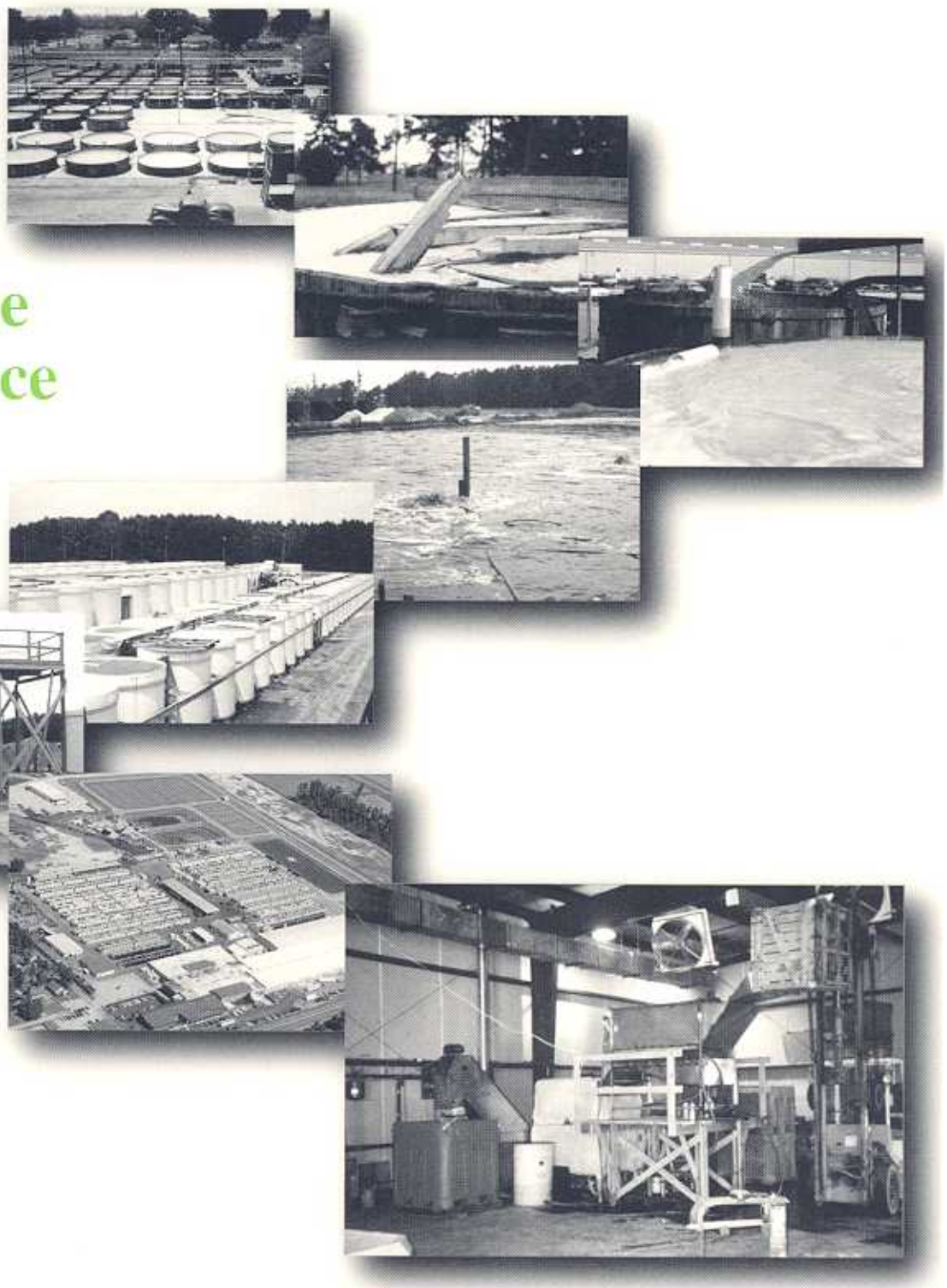
Bulk storage in brine has been an economic means of extending the processing season of pickling cucumbers since before the 1930's (1). When larger sizes of cucumbers began to constitute a higher proportion of the crop in the 1960's, bloater formation resulted in buoyancy force sufficient to rupture tank heading timbers (2), but purging of CO_2 from the brine reduced bloater damage and buoyancy forces within the tank (3). However, use of high concentrations of salt in brine storage requires washing of the excess from the brine-stock before conversion to finished products, which requires the use of aeration ponds to biodegrade the organic matter (4), but still results in problems in the handling of salt and other non-biodegradable wastes. The use of fiberglass and polyethylene tanks (5) has reduced salt leakage that was prominent with wooden tanks (1-3), but relatively high salt concentrations are still used to serve as insurance against vagaries of nature due to tanks being open to the atmosphere. Closed tanks have been considered by the industry (6), but various factors have resulted in modernized brine yards of open-top, fiberglass and polyethylene tanks and a waste handling system (7). This issue of the journal is devoted largely to summarizing efforts to design and test a pilot system (8) for preserving "process-ready," brined cucumbers with improved quality and reduced wastes, and with intended benefits to the producer and processor of pickling cucumbers.

"For Those Who THINK PICKLES"

Pickle Pak

SCIENCE

Bulk Storage in Brine Since the 1930's



A journal reporting research relating to brined, salted and pickled vegetables and fruit.