



United States Department of Agriculture

**Research, Education and Economics
Agricultural Research Service**

Public Statement

To: US Pickling Industry and/or Members of Pickle Packers International

Re: Status of the USDA-ARS CaCl₂ Fermentation Technology and Industrial Partnerships

Since its inception in 1935, it has been the mission of the **USDA-Agriculture Research Service's Food Science Research Unit** to develop improved processes for the preservation and utilization of vegetables which will enhance quality, retain nutrients, assure safety, reduce energy use, and minimize high salt processing wastes. This USDA-ARS research unit has helped the industry in the United States meet the highest standards of food quality and safety, and reduce environmental impact.

Relevant examples of the Unit's contributions to the U.S. pickling industry include, but are not limited to, (1) the currently utilized pasteurization parameters to manufacture shelf-stable products, (2) nitrogen/air purging methods for cucumber fermentation tanks to resolve the hollow cavities inside the processed fruits, which can cause losses of up to 30 percent, (3) the inception and development of the bag-in-box technology for reduced salt cucumber fermentations, and (4) evaluation of cover brine recycling procedures for commercial cucumber preservation to prevent billions of gallons of high chloride effluent waste waters from reaching the freshwater streams, and thousands of tons of salty sludge from reaching the landfills.

The Unit has proposed and is currently transferring knowledge to the industry regarding (1) precise standards for processing conditions that pickle producers need to achieve the 5-log kill of pathogens of public health significance, as required by the US Food and Drug Administration standards for process filling, (2) a sodium-free cucumber fermentation system to eliminate NaCl from industrial waste streams, (3) low-salt and low-acid acidification methods for preservation of fresh cucumbers in a process-ready formulation to reduce environmental pollution, (4) design of filtration methods to reclaim fermentation cover brines that will be free of microbes and off-flavors, and (5) development of methods for the incorporation of probiotic cultures in cucumber products.

Historically, the technologies developed by the USDA-ARS Food Science Research Unit have been transferred to the U.S. pickling industry without restrictions, given that the research behind such technologies was and is still funded with appropriated public funds. It is the intent of the USDA-ARS Food Science Research Unit to continue to support the U.S. pickling industry in accordance with the law by establishing goals and objectives in line with the needs of our stakeholders and American consumers. It is also in the Unit's best interest to continue to deliver science-based knowledge and technologies in ways that ensure they become publically available to the industry at large in a timely fashion.



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While ARS does have mechanisms in place to partner with individual companies and protect intellectual property, we have kept such activities to a minimum in the spirit of benefitting the industry nationwide. This is still valid. We will evaluate mechanisms for individual partnerships on a case-by-case basis with the primary goal of making new knowledge available industry-wide.

The calcium chloride fermentation technology was developed by the USDA-ARS Food Science Research Unit and translated to the commercial environment in partnership with the private sector, more specifically B&G Foods Inc., and Mount Olive Pickle Company. This technology challenges the traditional sodium chloride fermentation, which is a centuries-old process, in significant ways and has the potential to reduce chlorides from tank yard wastes by 60 percent to 80 percent.

Four commercial scale trials that included more than 150 fermentations have been performed in the past three years applying the CaCl_2 fermentation technology that was developed in the ARS-Food Science Research Unit. Fermentation microbiology and biochemistry, microbial stability at the factory scale, and aspects associated with product quality during long-term storage have been investigated. CaCl_2 fermented finished product attributes were within the typical range of finished pickle products and the products have been successfully commercialized.

The number of commercial tanks programmed for packing with the CaCl_2 cover brine formulation in 2014 will quadruple that of the experimental trials. It is expected that this new technology may be fully implemented in the next couple of years, resulting in millions of dollars in cost savings annually and preventing the disposal of tons of NaCl into waste water streams and landfills annually.

The successful implementation of the CaCl_2 fermentation system nationwide still requires further development. Utilization of the newly proposed CaCl_2 fermentation system requires the supplementation of fermentation tanks with starter cultures that can meet Kosher requirements. While the USDA-ARS Food Science Research Unit has made progress in the development of such cultures and the methods required for their manufacture, this is still a work in progress.

The impact of bulk storage and other production variables on the finished product quality of CaCl_2 fermented cucumber pickles is an area of active research in our unit. Tank yards exclusively operating on the CaCl_2 fermentations would need to develop cover brine recycling strategies to assure quality and safety of the finished products, which is an area of study still unexplored by the USDA-ARS Food Science Research Unit. Implementation of the technology in the colder states of the Union, where table salt is used to prevent freezing of the in-tank fruits, is still a challenge.

It is anticipated that the development of a new core system for cucumber fermentations will stimulate the senses for the development of innovative and sustainable processes. There could not be a more complementary activity than this to affirm that USDA-ARS Food Science Research Unit is accomplishing its mission. Management of such new innovations is to be defined by the industry itself. However, the CaCl_2 fermentation technology developed by the USDA-ARS is freely available to the entire industry.

The current state of that technology is the fermentation of cucumbers in brine that contains calcium chloride instead of sodium chloride, and is supplemented with a starter culture to induce rapid initiation of a lactic acid fermentation. This fermentation process can be used in closed containers under controlled conditions or in large, open-air tanks as a field operation. The calcium chloride fermentation has been tested with variable sizes whole cucumbers and cucumber cuts and nubs at the commercial scale. For tank yards, the CaCl_2 brine should be supplemented with potassium sorbate and air purging to

reduce the risk of yeast overgrowth, and preservatives may be added to stabilize tanks for long-term bulk storage if so desired.