New packaging technology may provide boost to vegetable growers, shippers

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Introduction

The use of Modified Atmosphere Packaging (MAP) technology is advancing from infancy to its adolescent stages. As the technology matures, new applications that make the technology adaptable and user-friendly will require validation. One such novel application for MAP is the SLX container system produced by SLX International, a San Luis Obispo-based corporation. The container is made of food-grade plastic with a hermetic seal capable of containing a modified inner atmosphere (Fig. 1). The container is re-usable and is considered a “green technology,” as opposed to paperboard containers that are single use and disposable. It is the intent of the investigators to use the SLX container for the optimization of shelf-life and shipping quality of California-grown perishable agricultural commodities. Primarily, fruits and vegetables applicable to MAP transport were studied. Research parameters include, but are not limited to, respiration rate of the commodity, color, taste, odor, and microbial load of the commodity, as well as extension of quality factors over time and distance shipped. Optimization of these parameters for various produce commodities will allow for extended market access of

Figure 1. Modified SLX containers showing sealed MAP film patches at forward and rear locations.
such shipped items. As regional markets are saturated, growers, packers, and shippers must seek distant markets. In addition, with the advent and expansion of the global marketplace, more and more people desire fresh, high-quality produce items, from California too, if they can get them. The main objective of the proposed study was to investigate and define the criteria and parameters necessary for optimization of quality, thus allowing for extended shipment of California agricultural commodities. This will allow for sale of fresh items all around the globe, especially to lucrative, previously inaccessible markets in Asia and Europe.

Executive Summary

The SLX International Inc. container was tested for its ability to facilitate the long-term storage of broccoli florets (Fig. 2). Containers were modified to develop and maintain optimal Modified Atmosphere (MA) conditions (2-5 percent O₂ and 15-20 percent CO₂). Modification and/or preparation of the containers included 1) vacuum purging of O₂, followed by replacement with N₂; 2) vacuum purging of O₂, followed by replacement with N₂ and CO₂; 3) injection-valve replacement with low gas-transmission rate (GTR) films; 4) injection-valve replacement with high GTR films; 5) inclusion of one or two 63.5mm-wide container-lid holes covered with low or high GTR films; 6) inclusion of one or two 63.5mm-wide container sidewall holes covered with non-perforated high GTR film; 7) inclusion of two 63.5mm-wide container sidewall holes covered with custom-perforated (macropore) film (Fig. 1). After each preparation, containers were packed with 18.14 kg (40 lbs) broccoli florets and placed in refrigerated storage. Depending on the experiment, containers were held for 14 days at 1.1°C or 3.33°C and ambient or 80 percent RH, followed by storage at 7.2°C. This regimen was intended to simulate temperatures during international shipment followed by those incurred during marketing (early results indicated that RH had negligible effect when the produce was held in the SLX container and, therefore, RH was not controlled for most experiments). In-package atmosphere within containers was monitored over the duration of each study.

All container modifications failed to maintain aerobic conditions within the containers for a period longer than 14 days, with the exception of the containers modified to have two sidewall holes covered with custom-perforated film and stored at 3.33°C. Therefore, only the florets stored using this method were sampled. Color and firmness were measured after 21, 28 and 42 days storage. Firmness was unaffected by MA treatment. The greenness of florets stored in the modified SLX containers was slightly less that that of florets stored in a commercial plastic bag. The lackluster performance of the modified SLX container was determined to be due to leakage of the containers at the box-lid seal point. After correcting the leakage problem, florets were again stored in containers modified to have two sidewall 63.5mm ports covered with custom-perforated film. Florets were sample only for color after 28 days continuous
Major Accomplishments

The research to date has primarily concentrated on development of an MA method for exporting broccoli florets, which will produce the desired gas atmosphere within SLX containers. The research at Cal Poly was successful and included the following results:

- Work performed indicated that two sidewall ports with macro-perforated film patches would yield the desired container modified atmosphere for broccoli florets. Based on this work, SLX International Inc. developed exchangeable film cartridges which would attach to the containers at the side ports. These cartridges will contain different MA film "patches" depending on the commodity to be shipped. The work to determine the correct perforation number and/or pattern on the patches has yet to be performed. However, it appears that SLX will apply for a patent or patents for these cartridges stemming from this research.

- Work performed indicated that SLX International had significant manufacturing problems with the gaskets used in the lids to seal the containers. SLX International has since indicated that this problem has been rectified.

- Research indicated that SLX containers, when used to produce a modified atmosphere suitable for broccoli florets, might act to significantly reduce the microbial load on the florets, thus reducing health risks as well as extending shelf life. Research to verify these initial observations has yet to be performed.

Impact Statements

- A successful MA system for export-quality broccoli florets has been developed based on cartridge-contained, macro-perforated film patches.

- This MA system will lend itself to a number of products, though the research to optimize the system for other commodities has yet to be performed.

- The research that has been performed has increased SLX International's position to economically benefit from the sale of its containers, and a patent or patents based on this technology appear to have been applied for.

- The research performed under the ARI suggests that a prime benefit of using the SLX container is decreased development of rot and slime during long-term storage of broccoli. If corroborated, this should greatly increase SLX International's ability to sell its product.

- This container/MA system fills a niche in marketing for an RPC, or re-usable plastic container.
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