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Use of Commercial Moisture Adsorbers to Increase the Shelf Life of Fresh Mushrooms

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ABSTRACT: The low water vapor transmission rates of conventional packaging films combined with the high transpiration rates of mushrooms quickly leads to nearly saturated conditions within a conventional package. The inpackage relative humidity of (IPRH) in a 225 g conventional package of fresh mushrooms was reduced by using moisture adsorbers such as montmorillonite clay and silica gel. The mushrooms were evaluated for their weight loss, color, 'and maturity index after 3, 6, and 9 days of storage at 12°C. The maturity index decreased and color values (degree of whiteness) were higher with the use of these adsorbers within the package.

1 INTRODUCTION

Most polymeric films utilized in conventional packages have lower water vapor transmission rates relative to transpiration rates of fresh produce. This leads to nearly saturated conditions within packages (Hardenburg 1973). The high in-package relative humidity (IPRH) can cause condensation within a package and allow microbial growth. High relative humidity (RH) may increase or decrease decay depending on the produce since they have different transpiration coefficients (Lentz and VandenBerg 1973) and have different water potentials (Cook and Papendick 1978). The recommended levels of RH for storage of fresh produce represent a delicate balance between desiccation of the commodity by low humidity and increased decay by high humidity (Hardenburg *et al.* 1986)

Moisture adsorbers such as calcium chloride have been used to prevent increase in RH within packages containing fresh fruits and vegetables (Eaves 1960). Shirazi (1989) used different moisture adsorbers to lower the RH of packages containing green tomato. A high equilibrium IPRH was attained using compounds like sorbitol, xylitol, NaCl and KCl and overdrying of tomato was avoided.

The effect of sorbitol, used as a moisture absorber, on the shelf life of fresh mushrooms in conventional packages overwrapped by PVC film with 2mm holes were studied by Roy *et al.* (1995). Surface moisture content of mushrooms was increasingly reduced with increasing amounts of sorbitol. Sorbitol also reduced the bacterial growth on mushrooms. An inpackage RH (IPRH) of 87% to 90% was found to result in the best color during storage. The objectives of this study were to evaluate the use of commercially available food-grade moisture adsorbers such as montmorillonite clay and silica gel for improving the quality and shelf life of fresh mushrooms.

2 MATERIALS AND METHODS

Mushrooms *Agaricus bisporus* of U-1 (hybrid off-white) strain were grown on traditional horse manure-based compost at the Mushroom Test and Demonstration Facility (MTDF) at the Pennsylvania State University. Freshly harvested mushrooms, free from any visual blotches, were transported within about one hour after harvest and were promptly placed in cold storage at 4°C before packaging. The study consisted of three treatments, namely, the control (mushrooms packaged without moisture adsorbers), mushrooms packaged with clay, and mushrooms packaged with silica.

2.1 *Packaging and storage*

Mushrooms were sorted on the basis of size and appearance. Diseased, damaged, open-veiled and extremely large or small mushrooms (25mm <cap diameter <40mm) were discarded. Acceptable mushrooms were selected at random, and mushrooms were placed into an 8-ounce linear polystyrene mushroom trays, so that each tray had around 225 g of mushrooms. Nine minipacks (3.5g each) of clay or silica (Multiform Desiccants Buffalo, NY) wrapped in Tyvek pouches were uniformly distributed through out the package. Two 3mm perforations were made at the top of each package, diagonally opposite to each other and equidistant from their nearest corners to ventilate the package. The packages were stored at 12°C and 80% RH in a low temperature incubator (model 815, Lunair Environmental, Inc., Williamsport, PA).

2.3 *Measurement of quality characteristics*

Mushrooms were chosen at random to evaluate the quality characteristics on day 0. The trays were selected at random from low temperature incubator after 3, 6 and 9 days of storage and all of the mushrooms in each tray were evaluated. Mushrooms were removed from the tray and weighed immediately to evaluate the loss in fresh weight. These mushrooms were then used to evaluate the maturity, and color of mushrooms.

2.4 *Color*

The color of mushrooms was measured using a Minolta Chroma Meter (CR-200, Dynamic Electronic Sales, Churchville, PA). Three measurements were taken at random locations on the cap of each mushroom and reported as L values (degree of whiteness).

2.5 *Maturity index*

The maturity index was determined according to Schmidt (1977) and modified by Guthrie (1984). The maturity index was assigned to mushrooms based on the extent of cap opening on a 7 point scale.

2.6 *Measurement of RH*

The IPRH within the packages of mushrooms was monitored during storage using a relative humidity probe (Vaisala, Woburn, MA).

3 RESULTS

As expected, mushrooms in the control treatment lost the least amount of weight after 3, 6, and 9 days of storage (Fig. 1). The weight lost by mushrooms packaged with silica and clay were similar at the end of 3, 6, and 9 days of storage.

The mushrooms in the packages with no moisture adsorbers had the lowest value of L after 3, 6, and 9 days of storage. The treatment with silica had better color values when compared to clay and after 3, 6, and 9 days of storage (Fig. 2).

The mushrooms with no moisture adsorbers had the highest value of maturity index after 3, 6, and 9 days of storage. The mushrooms packaged with silica and clay had lower values of maturity index (Fig. 3).

The RH in the mushroom package with clay varied from 68% to 95% over a period of 9 days of storage (Fig. 4), and the RH in the mushroom package with silica varied from 95% to 99% over a period of 9 days of storage.

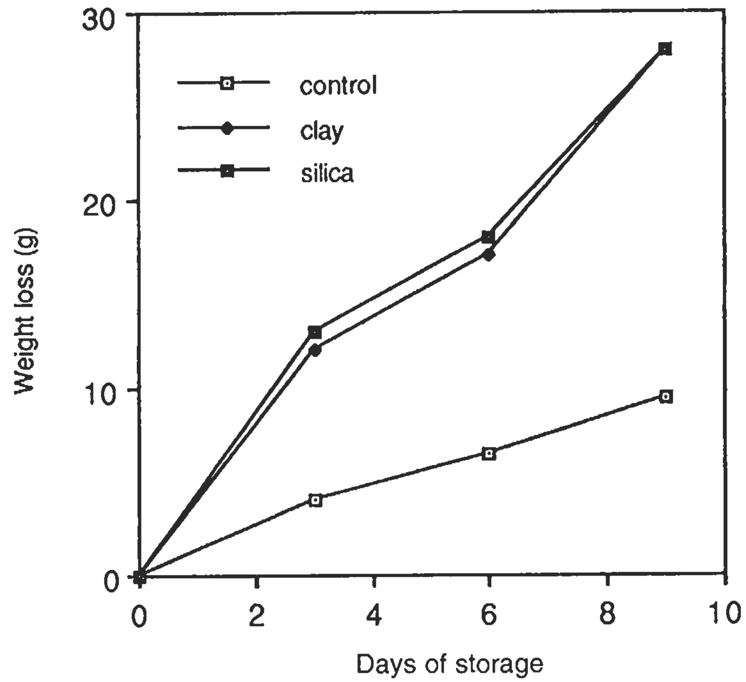

Fig. 1. Effect of moisture absorbers on weight loss by mushrooms during storage.

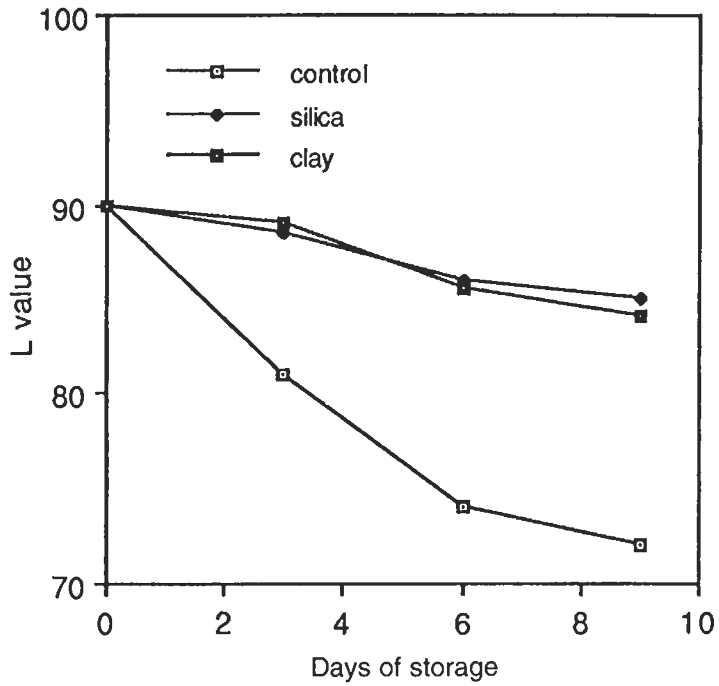

Fig. 2. Effect of moisture absorbers on L values of mushrooms during storage.

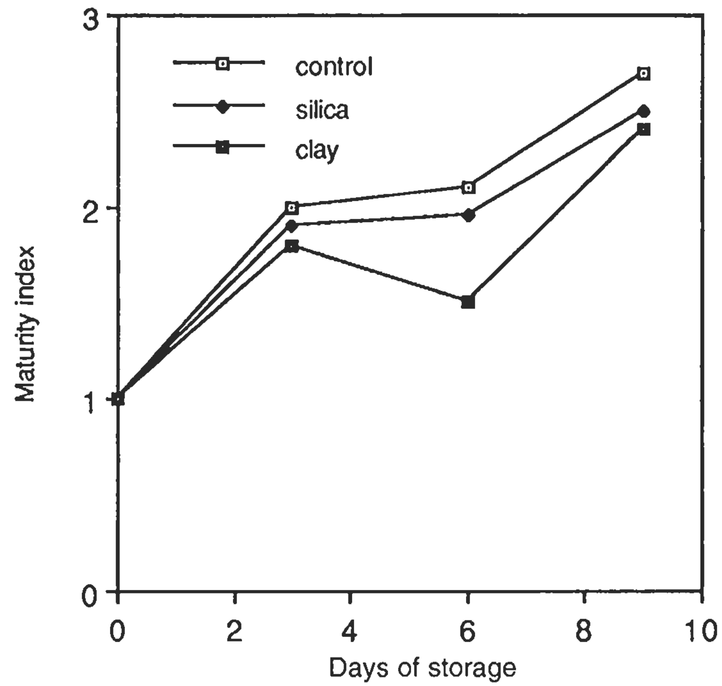

Fig. 3. Effect of moisture absorbers on the maturity index of mushrooms during storage.

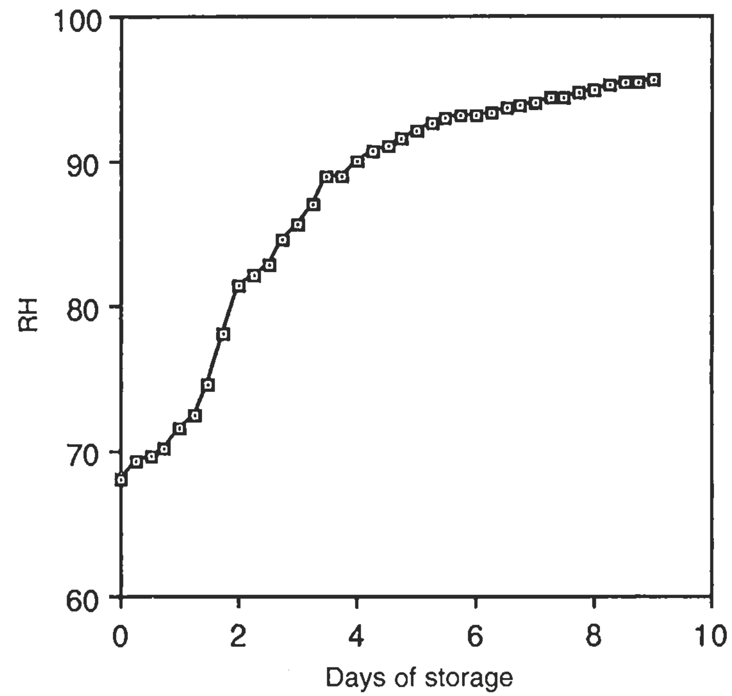

Fig. 4. RH in a mushroom package with clay minipacks during storage.

4 DISCUSSION

The mushrooms with clay and silica have a higher weight loss than control due to moisture lost to these adsorbers. The maximum weight loss at the end of 9 days in packages containing clay and silica adsorbers were less than 10%. The weight loss can be minimized by optimizing the number of minipacks of desorbers used with respect to product quality. The improvement in quality (lower maturity index and higher L value) with the addition of these desorbers can be explained on the basis of lowered IPRH within the package. The color values are better due to lowered growth of microorganisms on the surface of mushrooms as reported by Roy *et. al.* (1995). In conclusion, these commercially available adsorbers can be successfully used to improve the quality shelf life of fresh mushrooms.

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