Reducing Decay in Fresh Blueberries with Controlled Atmospheres

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Abstract. Freshly harvested blueberry fruit (Vaccinium corymbosum L.) were held for 7 or 14 days at 2°C under constant atmospheres of CO2 in air or with 2% O2, under 2% O2 alone or in normal atmosphere. When the berries were removed from the controlled atmospheres and held for 3 days at 21°C, the CO2-enriched atmospheres of 10%, 15%, or 20% significantly inhibited decay development for 1–2 days. The higher CO2-enriched atmospheres generally were more effective. The 2% O2 atmosphere alone was ineffective and did not enhance the CO2 treatment.

Blueberry fruit shelf life is limited by decay, principally gray mold rot (Botrytis cinerea Pers. ex Fr.), alternaria rot (Alternaria sp.), and anthracnose (Colletotrichum sp.), with the loci of infections primarily at the stem scar (1, 2, 3, 6). The foreign market potential for blueberries can be enhanced greatly if their shelf life can be extended sufficiently to cover the 12 to 14 days normally required for transport to European ports from the east coast of the United States (7). Effective control of decay in fresh blueberries was obtained with a combination of rapid precooling, a fungidal dip, and modified atmospheres during cold storage (4). However, the use of dips is resisted by growers because of the extra cost of handling and drying the berries.

Atmospheres enriched with CO2 were found fairly effectively in inhibiting blueberry postharvest decay without a fungicide treatment (5). Various atmospheres of CO2 in air were applied to film-packaged blueberries which then were cooled at different rates to 2°C. In that study, berry respiration and film leaks caused fluctuations in the package atmospheres during cooling and subsequent cold storage periods (5).

To determine more precisely the best atmosphere for disease control, we subjected fresh blueberries to several controlled atmospheres of CO2 and O2 during cold storage periods of 7 and 14 days in 1982 and 1983. Field trays, each with 12 uncovered, 1-pint (473 cm3) pulpboard containers of commercially hand-picked or mixtures of hand-picked and machine-picked freshly harvested blueberries were obtained from New Jersey growers. Pints were randomized in every test, cased with a plastic film and, in sublots of 6 pints each, inserted into a 4-ml thick polyethylene film envelope (32 x 44 cm) which was heat-sealed. The air in each envelope was evacuated and replaced with a prescribed atmosphere. Test atmospheres consisted of 10%, 15%, and 20% CO2 in air or with 2% O2, and residual N2, and 2% O2 with 98% N2 (Tables 1, 2, 3). Two envelopes with berries were connected serially to a cylinder (5.6–6.0 m3 gas) of each of 7 test atmospheres. A gas flow rate of about 3 liters/hr was maintained during storage of the berries at 2°C. Controls consisted of berries held in a normal atmosphere within unsealed film envelopes.

After 7 or 14 days, the 12 pints of berries were removed from the 2 envelopes of each test treatment. Three pints of each test treatment were examined for market quality immediately after cold storage and 3 pints each were examined after 1, 2, and 3 days at 21°C and 85% RH. Four tests of 14 days duration were completed in 1982 and 6 tests of 7 days and 4 tests of 14 days duration were completed in 1983.

The combined results of the 6 blueberry storage tests replicated during the 1983 harvesting season are presented in Table 1. There were no significant differences in decay among any of the treatments when the berries were held in normal atmosphere.
The benefits of storing blueberries in CO₂-enriched atmospheres during 14 days of cold storage were evident immediately following removal from the low temperature (Tables 2, 3). Berries that had the CO₂-enriched atmospheres had significantly less decay after the 1- and 2-day holding periods than those that had been stored in air or the 2% O₂ atmosphere. At the end of the 3rd day, decay continued to be suppressed, but the effectiveness of the CO₂ treatments was greatly diminished. Although more decay was observed in 1982 than in 1983, the disease control patterns were similar in both years (Tables 2, 3).

While the humidity was not measured during the cold storage of the berries, moisture condensation was observed within the envelopes, indicating the existence therein of a relatively high humidity. Decay development, however, was inhibited principally by the cold storage temperature. Humidity was a significant factor in berry decay during the holding period at the higher temperature without the CO₂-enrichment.

The results of these tests support previous findings that CO₂-enriched atmospheres can reduce postharvest decay development in blueberries during and after cold storage. Lowering the O₂ atmosphere to 2% in these tests did not reduce postharvest decay and often caused a poor flavor in the berries. Fresh blueberries stored for 7–14 days at 2°C in these tests benefited from a CO₂-enrichment of a normal atmosphere. Because a 20% CO₂-enrichment caused off-flavors in some berries, no more than a 15% CO₂-enrichment should be utilized.

**Literature Cited**