

Internal Browning In Fuji Apples

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Internal browning in Fuji apples is a physiological disorder which occurs during controlled atmosphere storage (CA) and therefore limits the use of CA for this cultivar. Early work at UC Davis identified high CO₂ atmospheres as being a major cause of browning and now Fuji apples are recommended to be stored in not more than 0.5% CO₂. However even at this atmosphere internal browning can be found in some lots of fruit. Further research aimed to characterize this disorder and determine storage conditions which might reduce its development were carried out in 1996-1997.

We harvested fruit from a number of Fuji apple orchards at several harvest dates, some of which we stored at 2% O₂ and 2% CO₂ at 0°C. Internal browning after storage increased with advancing harvest date but even at the same harvest date, there were considerable differences among individual orchards. Differences in fruit maturity indices such as starch pattern index, background color, fruit firmness and in watercore incidence measured at harvest could not explain this variability. We measured internal CO₂ concentrations within the fruit of Fuji apples at harvest and found them to be low and similar for all orchards and harvest dates. Skin resistance to CO₂ was also very low and although there were some differences between orchards they did not relate to internal browning incidence after CA storage. It therefore seems unlikely that orchards with different susceptibilities to internal browning have different amounts of CO₂ within flesh tissue when fruit are CA stored. It is more probable that tissue sensitivity to CO₂ plays some role in explaining this variability.

We were able to simulate internal browning symptoms which develop in apples stored under CA at 0°C (32°F) by placing some fruit under very high CO₂ atmospheres (20 or 50%) in air at 20°C (68°F). Under these conditions, visible browning symptoms were observed inside fruit within 1 - 3 days of exposure to these atmospheres. Further, variation amongst orchards in internal browning after CA storage was similar to that after 3 days of exposure to 20% CO₂ at harvest. Such a system might be useful to predict at harvest orchard susceptibility to internal browning under CA.

The first 4 weeks of CA storage appear to be important for the induction of internal browning. We found that internal browning developed during the first 2 to 8 weeks after placing fruit into CA storage (2% CO₂, 2% O₂) and there was little increase in incidence or area of internal browning after this time. A 4 week delay in air before CA was imposed considerably reduced the amount of internal browning which developed during 17 weeks of storage. Such a delay in CA produced slightly more yellow fruit than when CA was imposed immediately; however, there were no differences in fruit firmness, soluble solids concentration or titratable acidity. In contrast storage temperature (0 or 2.2°C; 32 or 36°F) did not influence internal browning or fruit quality. Studies to optimize the storage conditions for Fuji are continuing.

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