

LAFTA, ABBAS M. and KAREN KLOTZ FUGATE*, USDA-ARS, Northern Crop Science Laboratory, 1307 - 18th Street North, Fargo, ND 58105. **Dehydration accelerates root respiration and impacts sugarbeet raffinose metabolism.**

ABSTRACT

Sugarbeet (*Beta vulgaris* L.) roots produced in northern growing regions of North America, Europe and Asia are typically stored in large outdoor piles prior to processing. Roots are stored for up to 200 days in these piles which are cooled by ambient winter air either passively or actively by circulating air through ventilation pipes placed beneath the piles. The flow of cold winter air through storage piles inevitably results in root dehydration. Root dehydration generally increases with storage duration and is particularly severe in the outer portions of piles which are exposed to sun, drying winds, and freeze/thaw cycles that damage cellular membranes. Dehydration is associated with sucrose loss and decline in quality, but the metabolic processes that contribute to this decline are poorly understood. To identify processes that contribute to sucrose loss in dehydrated roots, respiration rate and raffinose oligosaccharides (raffinose and stachyose) and their precursors (*myo*-inositol and galactinol) were determined in sugarbeet roots during storage at high (85%) and low (40%) relative humidities.

Roots stored for 28 days at 40% relative humidity dehydrated significantly and their respiration rate was accelerated. At 40% relative humidity, roots lost almost 50% of their weight after 4 weeks of storage. Root respiration generally increased with time in storage at 40% relative humidity. The increase in root respiration during storage at low relative humidity was associated with weight loss. Electrolyte leakage also increased during storage at low relative humidity and reached 42% after 4 weeks of storage. The increase in electrolyte leakage in dehydrated roots suggests that plasma membranes were damaged as a consequence of dehydration. The increase in root respiration during storage at low relative humidity was closely associated with increases in electrolyte leakage.

Raffinose concentrations increased significantly during storage at high relative humidity, but decreased in dehydrated roots. There was an increase in *myo*-inositol and a decrease in galactinol concentrations during storage at both high and low relative humidities. There was a slight decrease in stachyose concentration in dehydrated roots but this decrease was not statistically significant. The observed decrease in raffinose level in dehydrated roots could be due to its degradation to its precursors (melibiose and *myo*-inositol), as these increased during storage.

The results of this study suggest that storage at low relative humidity can alter the postharvest physiology of sugarbeet roots by increasing weight loss, reducing membrane integrity, accelerating root respiration rate, and influencing raffinose metabolism. Since respiration occurs at the expense of sucrose, the elevated respiration rate of dehydrated roots is expected to increase storage sucrose losses. In addition, the increased respiration rate of dehydrated roots is expected to contribute to pile warming, since only a third of the energy released in the respiration of sucrose is captured in the chemical bonds of ATP. The remaining energy is dissipated as heat.