Title The role of invertase inhibitors in cold-induced sweetening of potato, a processing problem caused by postharvest storage

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Abstract

Potatoes need to be stored at low temperatures (8-12°C) to prevent sprouting, and the development of varieties that are resistant to low temperature storage is becoming increasingly important now that sprouting inhibitor chemical treatments are being phased out. Cold-induced sweetening of stored potatoes is a postharvest problem that leads to an accumulation of hexose sugars derived from starch breakdown, and develops during storage at low temperature for several months. When these potatoes are processed into crisps or chips, the cooking at high temperatures causes the hexose sugars to reaction with amino acids by the Maillard reactid to produce products with unacceptable dark brown or black discoloration. Several enzymatic activities may be involved in the cold-induced generation of hexose sugars, including UDP-glucose pyrophosphorylase, invertase and invertase inhibitors. We have examined the expression of invertase inhibitor genes in cultivars resistant to cold-induced sweetening and in cultivars susceptible to cold-induced sweetening. A cDNA library screen identified invertase inhibitor clones with predicted apoplastic and vacuolar localization. Two distinct vacuolar forms were found, differing in the deduced amino acid sequence at the carboxyterminus. Multiple allelic forms of the predominant vacuolar form were present in tetraploid potato. Invertase inhibitor mRNA accumulated to high levels during tuber development and after cold storage of mature tubers was higher in cultivars resistant to cold sweetening than in sensitive cultivars. Production of an antibody to the vacuolar invertase inhibitor allowed the spectrum of cross-reacting proteins present in a range of cultivars differing in cold sweetening sensitivity to be examined. These approaches will be used to reveal the role of invertase inhibitors in regulating cold sweetening.