PRECONDITIONING AND STORAGE OF CHEMICALLY IMMATURE RUSSET BURBANK AND SHEPODY POTATOES

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Abstract

Russet Burbank and Shepody potatoes of different chemical maturities (i.e., varying sucrose concentrations) at harvest were preconditioned by holding at 15 C for various durations to lower the concentration of reducing sugars to levels acceptable for processing as french fries out of 8 C storage. In chemically immature tubers (i.e., those harvested with a high sucrose), sucrose declined after harvest and stabilized in storage regardless of the preconditioning period. However, there was a temporary small increase in sucrose after harvest in more chemically mature tubers. The concentrations of the reducing sugars glucose and fructose were low at harvest, usually <1.0 mg g⁻¹, but increased rapidly during the first 30 to 45 d of storage in tubers with more than 2.0 mg g⁻¹ sucrose at harvest. Preconditioning for up to 70 d at 15 C either limited the increase in reducing sugars or lowered them more rapidly during storage than when preconditioned for only 14 d. Fresh weight loss of Russet Burbank and Shepody was greater in physically and chemically immature tubers compared to more mature tubers. Extended preconditioning of Russet Burbank and Shepody resulted in minimal additional weight loss.

Introduction

Potatoes are physically mature when vines have senesced and tubers have obtained a degree of skin set. Physiological maturity of tubers occurs when a peak of dry matter is attained which usually coincides with a minimum sugar content (5). However, tubers may be physically mature without being chemically mature (i.e., low sugar concentration). The level of sucrose in chipping potatoes should be 1.5 mg g⁻¹ or less at harvest to minimize accumulation of reducing sugars (glucose and fructose) in long term storage (12). Tubers high in reducing sugars produce dark french fries or chips upon frying due to the Maillard reaction (6) which is unacceptable for processing. Sucrose also contributes to chip color (7).

Russet Burbank, a late maturing potato cultivar, on occasion must be harvested before reaching chemical maturity, especially in northern production regions. Sucrose concentration varies among fields of Russet

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Burbank during the growing season (9) and may be high at harvest especially if environmental or cultural stresses delay chemical maturity. Preconditioning potatoes at temperatures of 13 to 16 °C after harvest aids wound healing and skin maturation while reducing sugars are respired (12).

The enzyme invertase hydrolyses sucrose to glucose and fructose and its total activity is greater in rapidly growing cells and in tissue undergoing a sudden stimulation of metabolism (8). Basal invertase activity (i.e. assayed in the presence of an inhibitor), was shown to be extremely low in all genotypes of potatoes at harvest (10). Total invertase activity (i.e. assayed after the inhibitor is destroyed) increased rapidly during the first few days of storage and resulted in an early accumulation of reducing sugars from the available sucrose pool.

A chemical maturity monitoring (CMM) system in which tuber sucrose and glucose contents are determined during the later stages of development in the field and in storage has been described (12). This technique provides management decisions, based on sugar concentrations, temperature, and ventilation conditions, to reduce sugars to acceptable levels before processing.

The sugar changes during storage of Russet Burbank and Shepody potatoes were determined to assess the effectiveness of preconditioning to lower reducing sugars in chemically immature tubers. The fresh weight loss resulting from preconditioning was also determined.

Materials and Methods

Plant Material

Plots were established within commercial fields of Russet Burbank potatoes and were managed by the grower with respect to fertilization, pest management, cultivation, and irrigation. Planting was in mid-May each year with a later planting on June 6, 1990. Russet Burbank was grown under dryland conditions at Graysville, Manitoba, Canada in 1987 and under irrigation at Portage la Prairie, Manitoba in 1988. Russet Burbank and Shepody were grown under irrigation at Graysville, Manitoba in 1989 and 1990. Fertilizer was applied on the dryland plot to give a total of 100, 60, and 250 and on irrigated plots to give 150, 60, and 250 kg ha⁻¹ NPK, respectively, with some of the N applied through the irrigation during the growing season.

In 1987, bulk samples of 100 kg of tubers were hand harvested on September 10 and 24 and divided into three sub-samples before preconditioning. A sprout inhibitor was not used in 1987. In 1988, 1989, and 1990 plots were randomized complete blocks with four replicates. Treatments consisted of different harvest dates to obtain tubers of varying physical and chemical maturities. Maleic hydrazide (Royal MH60, Uniroyal Chemical, Elmira, ON) at 5.65 kg ha⁻¹ in 300 L ha⁻¹ water, was applied for sprout