STARCH TO SUGAR INTERCONVERSION IN SOLANUM TUBEROSUM L.
I. INFLUENCE OF INORGANIC IONS.¹
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Abstract

No relationship could be found between calcium, magnesium, potassium, total phosphorous contents, and reducing sugar accumulation in apical and basal portions of Russet Burbank tubers. However, a highly significant positive correlation was found between inorganic phosphorous content of tubers and reducing sugar accumulation. Inorganic phosphorous and sugar levels were highest in the basal portion of moisture stressed and low temperature stored tubers, suggesting a relationship between inorganic phosphorous and enzymatic activity in the interconversion of starch to sugars in potatoes. Tubers stored at 5.5°C and 15.5°C had higher contents of calcium and magnesium in the basal portion and significantly higher potassium content in the apical portion. Storage temperatures or moisture stress during growth appeared to have no significant influence on calcium, magnesium, potassium or total phosphorus contents of the tubers.

Resumen

Ninguna relación fue encontrada entre calcio, magnesio, potasio, contenido total de fósforo y acumulación de azúcares reductores en las partes apical y basal de tubérculos Russet Burbank. Sin embargo, una correlación con alta significancia positiva fue encontrada entre el contenido de fósforo inorgánico de tubérculos y la acumulación de azúcares reductores. Fósforo inorgánico y niveles de azúcares fueron más altos en la parte basal de tubérculos de condición humeda desfavorable y almacenado con temperatura baja, sugiriendo una relación entre fósforo inorgánico y actividad enzimática de conversión de almidón a azúcares en papas. Tubérculos almacenados a 5.5°C y 15.5°C tenían contenidos más altos de calcio y magnesio en la parte basal y contenido de potasio significativamente más alto en la parte apical. La temperatura de almacenamiento o la escasez de agua durante el crecimiento no tuvieron aparentemente influencia significativa en los contenidos de calcio, magnesio, potasio o fósforo total de tubérculos.

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KEY WORDS: Starch to sugar conversion potatoes; influence of organic ions.
Introduction

The low temperature conversion of starch into sugars in potatoes is very well known but the biochemical and physiological mechanism is not clear. Russet Burbank potatoes stored at low temperatures do not accumulate reducing sugars uniformly in the apical and basal portions (7). Attempts to correlate activities of enzymes involved in starch-sugar interconversion with tubers stored at different temperatures have not been successful (2, 4, 8, 10, 12, 14, 15, 17). Uneven sugar accumulation in Russet Burbank tubers during low temperature storage results in problems for processors as such tubers produce fries with uneven color. Several inorganic ions are known to activate and inhibit some of the enzymes involved in starch to sugar conversion. Divalent ions such as calcium and magnesium are known to activate sucrose synthetase in the sucrose synthesizing direction (5, 18). Inorganic phosphate is known to influence the activity of many enzymes involved in starch-sugar interconversion (9, 13). This study has attempted to determine the relationship of potassium, calcium, magnesium, inorganic and total phosphorus contents to reducing sugar accumulation in the apical and basal portion of tubers subjected to moisture stress during growth and stored at different temperatures.

Materials and Methods

Russet Burbank tubers grown at the Washington State University Othello field station during 1976 were used in this study. Seed tubers were planted the third week of April and they were harvested in the middle of September. Moisture-stressed tubers were produced by shutting off water to specified rows for two weeks in early June. Tubers were stored at 5.5 C and 15.5 C for eight weeks. Part of the tubers stored at 5.5 C were transferred after five weeks of storage to 15.5 C for three weeks. Such tubers are referred to as reconditioned.

Tubers were separated into basal and apical portions and the skin of each portion was removed with a kitchen-type potato peeler. The tissue was cut into small pieces and frozen at -40 C before freeze drying. Freeze drying of the tissue was done in a Virtis 10-146 MR-BA freeze drier for 48 hrs. Freeze-dried samples were ground into fine powder in a Wiley lab mill grinder and stored at -40 C until analysis.

One gram of freeze-dried tissue was ashed at 650 C for 8 hrs. and inorganic elements were extracted with dilute hydrochloric acid (1:20). An aliquot was taken and diluted to appropriate concentrations. Potassium and calcium were determined by flame photometry. Magnesium was determined by atomic absorption. Total phosphorus was measured on extracts of ashed samples by the ammonium molybdate method (1).

Inorganic phosphorus was measured by extracting the freeze-dried tissue with 10% trichloroacetic acid. Filtrates were diluted and an aliquot