RAPID EXTRACTION AND SOLUBILIZATION OF POTATO STARCH WITH DIMETHYLSULFOXIDE

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Abstract

Dimethyl sulfoxide (DMSO) solubilization of starch from lyophilized potato tissue is equally quantitative and more convenient than solubilization in dilute alkali, especially when analysis of a large number of samples is necessary. Starch extraction with DMSO decreases the handling time of each sample by eliminating sonication, filtration, and centrifugation steps required by the NaOH solubilization technique.

Resumen

La solubilización de almidón en tejido liofilizado de papa con Dimetilo sulfoxido (DMSO) es igualmente cuantitativo y más conveniente que la solubilización en álcali diluido, especialmente cuando es necesario el análisis de un gran número de muestras. La extracción de almidón con DMSO disminuye el tiempo de manejo de cada muestra eliminando las fases de sanicación, filtración y centrifugación requeridos por la técnica de solubilización con NaOH.

Introduction

In our program to improve potato quality, we were interested in comparing starch content among our high protein tuber genotypes. We wished to employ a rapid, accurate potato starch quantitation technique such as that described by Varns and Sowokinos (4). This procedure, which involved the specific solubilization of starch with dilute alkali aided by sonication, was as sensitive and accurate (SD = 0.86%) as other more time consuming starch isolation and purification methods. However, each of the 3 extractions with 0.1 N NaOH involved sonication, centrifugation, and

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filtration, all of which proved tedious when large numbers of samples were analyzed (30 to 40 per day).

For the above reasons we attempted to develop a starch solubilization technique which would be faster than sonication in dilute NaOH. Libby (3) reported that purified wheat, corn, and potato starches were completely dissolved in acidic 90% dimethyl sulfoxide (DMSO) in less than 5 minutes at 55°C. Under these conditions the maximum solubility of the starch was about 0.1% (w/v). The purpose of this research was to determine whether DMSO interfered with the subsequent HCl hydrolysis and glucose quantitation via the glucose oxidase-chromogen system (Glucostat) and to determine whether DMSO solubilization of starch contained in lyophilized tuber tissue could be optimized for complete starch recovery compared to the alkaline extraction method.

Materials and Methods

β-D-glucose, purified potato starch and DMSO were obtained from Sigma Chemical Co. Previously described methods were used for starch hydrolysis (4), glucose quantitation (4), and preparation of the tuber tissue samples (1). Glucostat was obtained from Worthington Biochemical Co.

Results and Discussion

Concentration of DMSO for Optimal Starch Solubility

Initially the solubility of purified potato starch as a function of DMSO concentration was tested. Twenty ml of DMSO-water solutions from 80 to 100% (v/v) DMSO in 2.5% increments were acidified with 1 drop of 5 N HCl heated to 55°C in a water bath, and 15 mg of potato starch were added. After 30 minutes at 55°C each solution was microscopically examined for the presence of undissolved starch grains. Under these conditions the 87.5 and 90% solutions contained few and no visible starch grains, respectively. The 90% DMSO-water solution was utilized in the following experiments.

Effect of DMSO on HCl Hydrolysis and Glucose Quantitation Via Glucose-oxidase

A standard curve obtained with β-D-glucose was compared to that resulting from the acid hydrolysis and glucose analysis of a known amount of purified potato starch solubilized with DMSO. Duplicate starch samples were dissolved in 20 ml DMSO solution (0.065% w/v) and two 1 ml aliquots were hydrolyzed with HCl and neutralized as previously described (4). Appropriate aliquots were analyzed by the Glucostat system. 90% DMSO completely solubilized the purified starch and did not interfere with the glucose quantitation system (Fig. 1). The actual curve attained with