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ENZYMATIC PRODUCTION OF PANOSE FROM MALTOSE BY GLUCOSYLTRANSFERASE FROM *ASPERGILLUS FOETIDUS*

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Introduction

Panose is a glucosyl-oligosaccharide that has been demonstrated to promote the growth of beneficial *Bifidobacteria* in the gut (Kitahata, 1989). It can also be used as an anti-cariogenic sweetener, because it prevents the production of water-insoluble glucans by *Streptococcus mutans* and is not metabolized by many oral bacteria (Kuriki et al. 1992; Ooshima et al. 1988). Panose can be produced from maltose by the action of an intracellular glucosyltransferase from an *Aureobasidium* species (Hayashi et al. 1994). The objective of the present investigation was to determine the efficacy of an extracellular glucosyltransferase from a number of *Aspergillus* species as a biocatalyst for enzymatic production of panose from maltose.

Materials and Methods

Each glucoslytransferase-producing culture was grown 500-ml Erlenmeyer flasks, each containing 100 ml of the medium of Hayashi et al. (1994) (2.5% maltose, 1.5% yeast extract, 0.75% K_2HPO4, $MgSO_4.7H_2O$). After 48 h of growth at 30°C on a rotary shaker at 240 rpm, the mycelium was separated by filtration, and the filtrate was used as a source of the extracellular enzyme. A standard reaction mixture contained 0.5 ml of enzyme solution and 1.5 ml of 20% maltose in 0.05 M sodium acetate buffer (pH 4.9). After 15 h of reaction at 45°C, panose, maltose, and other sugars in the reaction mixture were analyzed by the HPLC method of Hang et al. (1995). All sugars were obtained from Sigma Chemical Co., St. Louis, USA.

Results and Discussion

Extracellular glucosyltransferases produced by four different fungal cultures were used in the enzymatic production of panose from maltose. The enzyme from *Aspergillus foetidus* NRRL 337 was found to give the highest yield of panose (557 g/kg maltose consumed). The yields of panose by glucosyltransferases from

Aspergillus niger NRRL 328, *Aspergillus niger* NRRL 2270, and *Aspergillus oryzae* ATCC 14605 were only 355, 423, and 435 g/kg maltose consumed, respectively.

Table 1 shows the effect of reaction time on the enzymatic production of panose from maltose at 45°C in 0.05 M sodium acetate buffer (pH 4.9) by glucosyltransferase from *Aspergillus foetidus* NRRL 337. Panose production increased rapidly between 14 and 36 h and reached a level of 43 g/L after 48 h of reaction. It appears that a longer reaction time would result in a further increase in the amount of panose produced in the reaction mixture.

Table 2. Time course of panose production from maltose by glucosyltransferase from *Aspergillus foetidus* NRRL 337

Time (h)	Maltose (g/L)	Panose (g/L)	Efficiency (%)[1]
0	160.3	0	0
4	150.9	5.7	60.6
8	142.0	10.8	59.0
14	128.2	17.2	53.6
24	114.9	26.9	59.3
36	94.6	36.2	55.1
48	76.7	43.0	51.4

[1]Based on the amount of maltose consumed

The yield of panose and isomaltose from maltose by the intracellular glucosyltransferase from an *Aureobasidium* species has been reported to be 42.4% (Hayashi et al. 1994). In the present investigation, the extracellular glucosyltransferase from *Aspergillus foetidus* NRRL 337 was found capable of converting maltose to panose with a yield of up to 60% based on the amount of maltose consumed. Isomaltose, however, was not detected in the reaction mixture. Therefore, the results of these experiments strongly indicate that the extracellular glucosyltransferase from *Aspergillus foetidus* NRRL 337 can serve as a biocatalyst for the enzymatic production of panose from maltose.

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