Formation of Glucose Isomerase by *Streptomyces* sp.

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It is well known that many kinds of microorganisms produce glucose isomerase* when they are cultured in a medium containing D-xylose. In previous papers,¹⁻³⁾ the author reported that *Streptomyces* sp. YT-No. 5, which has the ability to assimilate xylan, produces glucose isomerase when it was cultured in a medium containing xylan or xylan-containing materials such as wheat bran, corn cobs, or corn husks etc. This strain produced xylanase in the culture fluid, however, it was found that the main product from xylan by this xylanase was xylobiose. On the basis of this finding, the formation of glucose isomerase by the strain with xylobiose and D-xylose was investigated.

Cultivation of *Streptomyces* sp. YT-No. 5 and induction experiments of glucose isomerase were carried out as follows:

Streptomyces sp. YT-No. 5 was cultured on the reciprocal shaker in a medium containing 1 g, polypeptone; 0.3 g, K_2HPO_4 ; 0.1 g, $MgSO_4 \cdot 7H_2O$ and 1 g, glucose in 100 ml of distilled water for 16 hr at 30°C. After cultivation the cells were collected by centrifugation, washed and resuspended in distilled water (cell concentration, 10~15 mg/ml as dry matter). Five milliliters of the cell suspension was added to 5 ml of the induction medium containing 0.05 M, phosphate buffer (pH 7), 2%, polypeptone; 0.01 M, $MgSO_4$; 0.002 M, $CoCl_2$ and the indicated amount of xylobiose or D-xylose in the flask of 50 ml capacity, and shaken at 30°C on a rotary shaker (200 rpm). At every two hrs, 2 ml of aliquots was taken out and the activity of glucose isomerase was assayed by the author's method previously reported.¹⁾

Figure 1 shows the time courses of formation of glucose isomerase by *Streptomyces* sp. YT-No. 5 with xylobiose and/or D-xylose. As clearly shown in this figure, not only D-xylose but also xylobiose had the ability to induce glucose isomerase, and it was found that the presence of both xylobiose and D-xylose strongly

ly stimulated the formation of glucose isomerase.

Figure 2 shows the effect of concentration ($6 \times 10^{-4} \sim 5 \times 10^{-1} \%$) of xylobiose and D-xylose on the formation of glucose isomerase by *Streptomyces* sp. YT-No. 5.

FIG. 1. Time Course of Induction of Glucose Isomerase of *Streptomyces* sp. YT-No. 5.

Experimental condition was the same as the standard condition except that the cell concentration was 5.6 mg as dry matter.

x—x, xylobiose, 0.5%; ●—●, D-xylose, 0.5%; ○—○, xylobiose, 0.2%; △—△, xylobiose, 0.1%; D-xylose, 0.4%.

FIG. 2. Effect of Concentration of Xylobiose or D-Xylose on Formation of Glucose Isomerase of *Streptomyces* sp. YT-No. 5.

Experimental condition was the same as the standard condition except that the cell concentration was 4~7 mg as dry matter.

○—○, xylobiose; x—x, D-xylose.

* According to the International Union of Biochemistry, Enzyme Commission in Enzyme Nomenclature, the enzyme may be classified as D-xylose ketol-isomerase (the trivial name, xylose isomerase, EC5.3.1.5).

As it is clear from the figure, the rate of formation of glucose isomerase with xylobiose was 10~15% larger than that with D-xylose. The rates reached approximately maximum at around 0.02% of xylobiose or D-xylose concentration and remained almost constant at these concentrations. These optimal concentrations of the inducers for the inductive formation of glucose isomerase by *Streptomyces* sp. YT-No. 5 are very low compared with that of *Bacillus coagulans*, strain HN-68, i.e., the optimal concentration of D-xylose for the formation of glucose-isomerizing enzyme of *Bacillus coagulans*, strain HN-68 is around 2%.⁴⁾

Streptomyces sp. YT-No. 5 could produce glucose isomerase in good quantities even when the strain was cultured in a medium containing xylan.^{1~3)} The reason

for this result, may be that the maximal rate of formation of glucose isomerase by this strain is attained at a very low concentrations of inducer (such as 0.02% and such amounts of inducer (xylobiose) can be sufficiently supplied by hydrolysis of xylan by the xylanase produced by this strain.

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