

Industrial production of branching enzyme, and its application for producing a highly branched cyclic dextrin, Cluster DextrinTM

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Starch is a mixture of two distinct polymers, amylose and amylopectin. Amylose is essentially linear glucose polymer of which the glucosyl units are connected by alpha-1,4-glycosidic linkages. Whereas amylopectin is a branched polymer, which is composed of short amylose chains connected together with alpha-1,6 linkages to form characteristic cluster structure. Starch is often processed using enzymes to produce glucose, maltose, maltooligosaccharides, maltodextrin, or dextrin, and they have been used in various industries including food, pharmaceutical, paper, textile, cosmetics, and chemical industries. In these enzymatic processes, hydrolytic enzymes such as alpha-amylase have been mainly used. Contrary, we have focused on potential of transferases as starch processing enzymes, and started a development of one of the transferases, branching enzyme, in 1993.

Branching enzyme (BE, EC 2.4.1.18) is involved in the formation of branch linkages (alpha-1,6 linkages) of starch and glycogen *in vivo*. On the other hand, in the course of studies of BE action on amylopectin, we found that BE mainly acted on the inner chains connecting the cluster units of amylopectin. This reaction resulted in cyclization of the inner chains, and degradation of amylopectin to large cyclic glucans with a limited molecular size (highly-branched cyclic dextrin, HBCD). HBCD has following properties.

- 1) HBCD is highly soluble in water, and the solution is highly soluble during storage.
- 2) HBCD has low unfavorable taste derived from starch compared with other dextrins.

- 3) The sweetness of HBCD is low compared with those of dextrans with relatively high DE.
- 4) HBCD is completely degraded to glucose with homogenate of rat intestine (including digestive enzymes) with comparable rate to conventional dextrin.

The productivity of BE was improved to several thousands-fold from that of original strain through mutagenesis and optimization of culture condition. Scale-up of cultivation was also achieved. After the investigation of production process of HBCD in industrial scale, HBCD has been launched on the market in Japan in 2002 as food material with a trade name of Cluster DextrinTM. HBCD is used for improvement of taste of food, as component of sports drink, as spray-drying aide, and so on.