

The Quinoprotein Glycerol Dehydrogenase Functions with Cytochrome *bo*₃ in *Gluconobacter* Respiratory Chain to Produce L-Sorbose and 5-Ketogluconate

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Gluconobacter is able to oxidize various kinds of sugars and sugar alcohols incompletely to accumulate corresponding oxidation products. Such the oxidative fermentation is important for industrial production of L-sorbose, 2-keto-D-gluconate (2KGA) and 5-keto-D-gluconate (5KGA), dihydroxyacetone and so on. These reactions are performed by PQQ-quinoproteins or FAD-flavoproteins linked to terminal oxidase(s) of the respiratory chain, which leads not only the accumulation of oxidative products but also the energy generation for cell growth.

Recent works^{1,2} have shown that a PQQ-glycerol dehydrogenase (GLDH), isolated 22 years ago³, is a central enzyme, catalyzing versatile polyol oxidation, responsible to almost all oxidative fermentations. Another works⁴ have shown that terminal ubiquinol oxidase in the respiratory chain, accepting electrons from the primary dehydrogenases, of *Gluconobacter* is branched with a cyanide-sensitive cytochrome *bo*₃ and a cyanide-resistant bypass oxidase. Recently, *cydAB* gene in *Gluconobacter* genome turned out to be highly homologous to *cioAB* in *Pseudomonas*, and actually shown to be responsible for the cyanide-resistant bypass oxidase (CIO).

Our recent studies on sorbose or ketogluconate fermentation have shown two sets of primary dehydrogenase, GLDH and FAD-sorbitol dehydrogenase (SLDH) or GLDH and FAD-gluconate dehydrogenase (GADH), are involved in the sorbitol or gluconate oxidation, respectively. It was revealed that a strain defective in GLDH exhibited a delayed sorbose production, decreased sorbitol oxidase activity, which became more resistant to cyanide, and generated less energy than either wild or SLDH-defective strain. For gluconate oxidation, it was shown that a mutant defective in GLDH converts gluconate only to 2KGA with a delayed but increased production, while GADH-defective mutant to produce only 5KGA but it is not so effective due to the slow growth rate. A mutant defective in CIO, though exhibited a slow growth, did increased 5KGA production in the resting cell reaction. Thus, 5KGA-producing gluconate oxidation with GLDH seems to be more closely linked to cytochrome *bo*₃ than CIO.

These results suggested that PQQ-GLDH connects efficiently to cytochrome *bo*₃ and plays a main role in the sorbose or 5KGA production; on the other hand, FAD-dependent SLDH or GADH links preferably to CIO, which may not produce so much energy, and work for additional production of sorbose or 2KGA which may be important for the cell growth.

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