The diversity of biological carbon dioxide pathways and biochemical understandings on their evolutional processes

Yasuo IGARASHI
(The University of Tokyo, Division of Agricultural and Life Sciences,
Department of Biotechnology, Professor.)

【Outline of survey】

The biological carbon dioxide is the only way on this planet to produce significant amounts of organic matters such as food/feed from carbon dioxide. In this project, the biochemical mechanisms and genetic background of various carbon dioxide reactions occurring in each of 4 fixation pathways known to date. Especially in the reductive TCA cycle, 4 carboxylation enzymes are believed to be originated from the corresponding decarboxylation enzymes which catalyze the reverse reaction (decarboxylation). This project will clarify how the decarboxylation enzymes acquire the ability of carboxylation by examining the structures and reaction mechanisms of those enzymes.

This kind of research is essential to understand the ability of carbon dioxide fixation on the Earth, effects of increased amount of atmospheric CO2 on living matters, and finally greenhouse effect of atmospheric CO2.

【Expected results】

(1) The precise mechanism of organization of inorganic carbon will be clarified, and the amount of biologically fixed carbon dioxide on the Earth can be estimated more accurately and in detail.
(2) The effect of increased amount of atmospheric carbon dioxide on the efficiency of biological carbon dioxide fixation can be estimated precisely.
(3) New concepts on the fermentative production of organic acids, amino acids, alcohol etc. will be obtained by deeper understanding of the central metabolism of microorganisms.

【References by the principal researcher】

(1) Occurrence, biochemistry and possible biotechnological application of the 3-hydroxypropionate cycle. Masaharu Ishii, Songkran Chuakrut, Hiroyuki Arai, and Yasuo Igarashi, Appl. Microbiol. Biotechnol., 64, 605-610 (2004)
(2) A novel enzyme, citryl-CoA synthetase, catalysing the first step of the citrate cleavage reaction in *Hydrogenobacter thermophilus* TK-6 , Miho Aoshima, Masaharu Ishii, and Yasuo Igarashi, Mol. Microbiol., 52 (3), 751-761 (2004)

【Term of project】 FY 2005 - 2009 | **【Budget allocation】** 79,200,000 yen

【Homepage address】 http://amb.bt.a.u-tokyo.ac.jp