

Abstract of Presentation

Novel enzyme discovery and metabolic engineering in hyperthermophiles

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Abstract :

Thermococcus kodakarensis is a hyperthermophilic archaeon isolated from Kodakara Island, Kagoshima, Japan. The organism is an obligate anaerobe and heterotroph, and displays an optimal growth temperature of 85°C. We have previously determined the entire genome sequence of *T. kodakarensis*, and have estimated the presence of 2,306 genes. Assignment of gene function based on primary sequence analysis is possible for approximately half of the genes, and this enables us to predict the presence or absence of particular metabolic pathways in this archaeon. Intriguingly, in many cases, although biochemical data suggest otherwise, there are pathways that are incomplete judging from the genome data. One of the main objectives of our research is to identify the enzymes or pathways that functionally replace these missing enzymes.

In this presentation we will introduce several studies on novel metabolic enzymes discovered in *T. kodakarensis*, focusing on pentose biosynthesis, amino acid catabolism and energy metabolism. The majority of the archaea do not utilize the classical pentose phosphate pathway for nucleotide biosynthesis. In a collaboration with the group of Prof. Yasuyoshi Sakai, we have found that pentose biosynthesis in *T. kodakarensis* is carried out through a reverse flux of the ribulose monophosphate pathway. We have also identified a novel metabolic pathway that may be involved in nucleotide degradation via the function of Type III Rubiscos. In terms of amino acid catabolism, we have identified and characterized multiple NDP-forming acyl-CoA synthetase homologs. The substrate specificities of these enzymes allow us to predict the amino acids that are catabolized in *T. kodakarensis*. The electrons obtained from amino acid oxidation are released via pathways involving hydrogenase homologs, whose functions will be discussed. Initial studies to alter the metabolism of this hyperthermophile are under way and will be presented.