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# BIOFUELS AND BIOENERGY

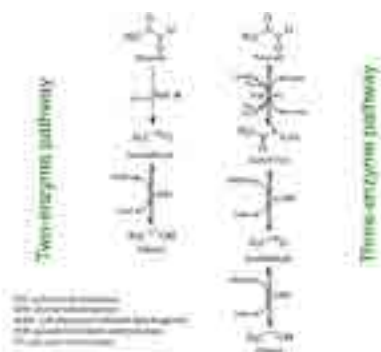
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## Thermostable pyruvate decarboxylases are key enzymes in the alcohol fermentation at high temperatures

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Many anaerobic hyperthermophiles can grow on carbohydrates and peptides and produce ethanol as an end product. Alcohol dehydrogenases (ADHs) catalyze the final step of the ethanol production from acetaldehyde; however, there is a lack of understanding of the enzyme catalyzing the production of acetaldehyde at high temperatures. No homolog genes are found to encode commonly-known pyruvate decarboxylase (PDC) and CoA-dependent aldehyde dehydrogenase respectively. A novel bifunctional PDC is present in *Pyrococcus furiosus*, which catalyzes both oxidative (pyruvate ferredoxin oxidoreductase, POR) and non-oxidative (PDC) decarboxylation of pyruvate, producing acetyl-CoA and acetaldehyde, respectively. Our results showed that the PDC activities were also present in hyperthermophilic archaeon *Thermococcus guaymasensis* (Tg) and bacteria *Thermotoga maritima* (Tm) and *Thermotoga hypogea* (Th). Coenzyme A or desulfo-CoA was required for the PDC activity. PDC and POR activities were co-eluted during different steps of chromatography. All three purified enzymes from Tg, Tm and Th were revealed to be a hetero-tetrameric protein using SDS-PAGE. The purified Tg enzyme had PDC activity of  $3.8 \pm 0.22$  U mg<sup>-1</sup> with optimal pH-value of 9.5. The optimum pH for both TmPDC and ThPDC was 8.4, while specific activities of PDCs were  $1.9 \pm 0.4$  U/mg and  $1.4 \pm 0.2$  U/mg for Th and Tm, respectively. Another PDC activity ( $25.94 \pm 0.6$  U/mg) was also identified in *T. maritima*, which also had acetohydroxyacid synthase (AHAS) activity. It was concluded that the bifunctional PDC and POR enzyme is present in hyperthermophilic archaeon *T. guaymasensis* and bacteria *T. maritima* and *T. hypogea*, and the bifunctional PDC and AHAS is also present in *T. maritima*. These bifunctionalities are likely a common property of the same type of enzymes in hyperthermophiles. Further studies of these thermostable PDC enzymes are required for bioengineering a more efficient alcohol fermentation process at high temperatures.



### Biography

Kesen Ma is a Microbiologist, graduated from the Department of Biology, Wuhan University. After graduated with an MSc degree from the Institute of Microbiology, Chinese Academy of Science (CAS), he went to Germany as a Max-Planck-Institute Fellow and obtained his PhD from Philipps-University Marburg. He worked as a Research Associate at the University, and a Postdoctoral Fellow and then an Assistant Research Scientist at the University of Georgia, United States. He became a Graduate Faculty at the Department of Biochemistry and Molecular Biology at the University of Georgia. He is an Associate Professor in the Department of Biology at the University of Waterloo, Canada. His current research has a focus on enzymology, metabolism, bio-processing and biotechnological applications of hyperthermophilic microorganisms.

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