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How does *Thermoanaerobacter ethanolicus* regulate its ethanol fermentation pathway?

Thermoanaerobacter species can efficiently use lignocellulose derived substrates to grow at temperatures above 70°C. *T. ethanolicus* produces ethanol as main fermentation product. The final steps of the ethanol fermentation pathway are redox reactions from acetyl-CoA to ethanol via an acetaldehyde intermediate. AdhA, AdhB and AdhE encoded by genes *adhA*, *adhB* and *adhE* are the key aldehyde/alcohol dehydrogenases to catalyze these reactions. After identifying *adhE* in *T. ethanolicus*, we find that the ethanol titer of fermentation is controlled by both transcriptional regulation and the properties of AdhA, AdhB and AdhE. The transcription of dehydrogenase genes is regulated by redox sensing protein, which binds to operators of different affinities so that *adhA*, *adhB* and *adhE* are expressed at directed time. Real time PCR results show that cells transcribe *adhB* in the absence of ethanol while the transcription of *adhA* and *adhE* needs be induced by a low concentration of ethanol. Further increased ethanol concentrations inhibit the transcription of all these genes. Under imitating physiological conditions, the enzyme AdhE and AdhB play crucial roles of aldehyde and alcohol dehydrogenases, respectively, in ethanol formation. However, the propertied and physiological roles of AdhA were not determined until the enzyme is successfully expressed and purified recently. The main physiological function of AdhA is to control ethanol titer by sensing and consuming ethanol in growing cells. After *T. ethanolicus* JW200 was transformed by *adhA* or/and *adhE* expression plasmids, the homologous expression of *adhE* enhanced the ethanol production, while that of *adhA* reduced the ethanol fermentation levels. These results supports a regulation theory: The limitation of ethanol concentration during fermentation is caused by a systematic regulation through transcriptions and activities of the key enzymes in the ethanol-formation pathway.

Biography

Weilan Shao obtained PhD degree in 1993 from the University of Georgia and had Postdoctoral studies in the University of Wisconsin. She has been a Professor in China since 2000. She has published more than 100 papers and has been serving as an Editorial Board Member of Chinese Journal of Biotechnology.

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