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'Green Genes' in Yeast May Boost Biofuel Production by Increasing Stress Tolerance

An effort to increase biofuel production has led scientists to discover genes in yeast that improve their tolerance to ethanol, allowing them to produce more ethanol from the same amount of nutrients.

A new study, published in the December 2010 issue of *Genetics*, shows how genetically altered yeast cells survive higher ethanol concentrations, addressing a bottleneck in the production of ethanol from cellulosic material (nonfood plant sources) in quantities that could make it economically competitive with fossil fuels.

"Our hope is that this research will take us closer to the goal of producing cheap, efficient, and environmentally friendly cellulosic ethanol," said Audrey P. Gasch, Ph.D., a Researcher involved in the work and an Assistant Professor of Genetics from the University of Wisconsin-Madison. "At the same time, we've learned a lot about how cells respond to alcohol stress. So the project has been very productive from multiple angles."

To make this discovery, scientists turned to nature, studying how natural strains of the yeast *Saccharomyces cerevisiae* respond to ethanol treatment. They concluded that many wild strains of yeast respond to ethanol much differently than do traditional laboratory strains. When these wild yeast cells were treated with a low dose of ethanol, they mounted a response to become super-tolerant to high doses. By comparing and contrasting strains with different responses

to ethanol, the researchers were able to quickly identify the specific genes responsible for the increased ethanol tolerance. They identified all genes in the yeast genome whose expression was affected when cells responded to ethanol. Comparing the responses of wild strains and a laboratory strain pointed the researchers to genes involved in high ethanol tolerance. The researchers were able to coax super ethanol tolerance in the laboratory strain by increasing expression of these genes.

"A lot of people think yeast is only useful to make beer, wine and bread," said Mark Johnston, Editor-in-Chief of the journal *Genetics*, "but it is also a key player in making 'green,' sustainable fuel sources part of the world's economy. By genetically priming these organisms to produce more ethanol, Gasch and her team have taken an important step away from fossil fuels."

Jeffrey A. Lewis, Isaac M. Elkon, Mick A. McGee, Alan J. Higbee, Audrey P. Gasch. Exploiting natural variation in *Saccharomyces cerevisiae* to identify genes for increased ethanol resistance. *Genetics*, 2010; 186: 1197-1205 DOI: 10.1534/genetics.110.121871