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The damaging effects of short chain fatty acids on *Escherichia coli* membranes

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Abstract

Products from fermentation are often inhibitory or toxic to the biocatalyst. In most cases, the mechanisms of toxicity are either unknown or poorly understood. The specific growth rate of *Escherichia coli* in the presence of hexanoic, octanoic, or decanoic fatty acid was measured; these compounds were completely inhibitory at 40 mM, except decanoic acid, which was inhibitory at 20mM. Octanoic acid-adapted *E. coli* had a higher tolerance of octanoic acid than unadapted *E. coli.* Measurement of membrane fluidity and intracellular magnesium leakage provide insight into the possible mechanisms of inhibition. Octanoic acid significantly decreased the membrane polarization and increased the leakage of magnesium from the cells. In contrast, the effect of ethanol and heat shock was minimal. Membrane lipid composition and surface hydrophobicity were measured to quantitatively describe the differences in adapted and unadapted *E. coli* cells. The membrane lipids were measured after adaptation to ethanol, octanoic acid, or heat shock. In all cases, the saturated: unsaturated lipid ratio increased under stress, but the relative distribution of lipids differed, giving rise to differences in the average lipid length. Adapted *E. coli* showed a decrease in surface hydrophobicity. Knowledge of these effects can help in the engineering of robust biocatalysts for biorenewable chemicals production.

Biography

Liam Royce is a Ph.D candidate at Iowa State University under the direction of Assistant Professor Laura Jarboe. Jarboe has 17 papers published in top microbiology and biotechnology journals. This work was supported by the NSF Engineering Research Center for Biorenewable Chemicals (CBiRC), NSF award number EEC-0813570.