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Modulation of *Listeria monocytogenes* Carbon Metabolism by Short Chain Fatty Acids

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Research Objective: Understand how physiologically relevant fermentation acids interfere with *Listeria’s* central carbon metabolic pathway

### Background

- *Listeria monocytogenes* is an intracellular bacterial pathogen
- Carbon metabolism in the presence of physiologically relevant SCFAs is still being investigated
- SCFAs in the gut have been linked to diseases: thrush, diabetes, and immune regulation of T cells
- Immunologically compromised individuals are more susceptible to *Listeria* infections

### Research Methods

#### I. Acetoin Assay

To determine how propionate alters carbon metabolism, we performed a cell suspension assay where aerobically grown bacteria were harvested, concentrated, and resuspended in fresh media supplemented with propionate and/or glucose:

<table>
<thead>
<tr>
<th>Propionate</th>
<th>Glucose</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>No supplementation</td>
</tr>
<tr>
<td>2</td>
<td>25 mM</td>
</tr>
<tr>
<td>3</td>
<td>50 mM</td>
</tr>
<tr>
<td>4</td>
<td>100 mM</td>
</tr>
<tr>
<td>5</td>
<td>25 mM</td>
</tr>
<tr>
<td>6</td>
<td>No supplementation</td>
</tr>
<tr>
<td>Acetate</td>
<td>25.5 mM</td>
</tr>
<tr>
<td>Propionate</td>
<td>2.25 mM</td>
</tr>
<tr>
<td>Butyrate</td>
<td>2.25 mM</td>
</tr>
</tbody>
</table>

#### II. LDH Activity in Response to SCFAs

- Acetoin production increased with propionate supplementation in a dose-dependent manner
- This increase in acetoin production was not a result of stimulating glucose oxidation
- Increased SCFA concentration also increases acetoin production, but the response is dose independent

#### III. ΔmenB mutant

These mutants cannot synthesize menaquinone, an important component of the ETC. Thus, quantifying their LDH activity can give insight into the mechanisms the bacteria use in switching from aerobic respiration to anaerobic fermentation.

### Conclusions and Future Work

I. *Listeria* is capable of modifying its central carbon metabolism to produce more acetoin in response to propionate, likely by incorporating propionate into its carbon metabolism

II. Anaerobic LDH activity was inhibited with the addition of SCFAs in a dose dependent manner, perhaps due to enzymatic saturation or pH conditions

III. The absence of menaquinones inhibits *Listeria’s* anaerobic LDH activity

Future work: ¹³C-NMR analysis of metabolites and experimental conditions with butyrate, acetate, and propionate alone.

### Acknowledgments

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