Process considerations for use of galactose oxidase as an industrial biocatalyst

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Volatility of the product is a limiting factor. This may be avoided by using alternative aeration methods, such as dead membrane aeration. On the other hand the volatility could be utilized to selectively remove and concentration the product from the reaction mixture.

**Kinetic modelling**

\[
\frac{r}{V_{\text{max}}} = \frac{S (O + \frac{S}{K_{S}})}{(S + K_{m}S + K_{M}O)(1 + \frac{S}{K_{S}})}
\]

**Table 1. Kinetic parameters obtained by non-linear regression of the rate expression to initial rate data.**

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Estimated value</th>
</tr>
</thead>
<tbody>
<tr>
<td>(k_{\text{cat}})</td>
<td>15 μmol/min/mg CFE</td>
</tr>
<tr>
<td>(K_{m})</td>
<td>36.8 mM</td>
</tr>
<tr>
<td>(K_{M})</td>
<td>3.0 mM</td>
</tr>
<tr>
<td>(K_{S})</td>
<td>196.5 mM</td>
</tr>
<tr>
<td>(a)</td>
<td>3.06 mM</td>
</tr>
</tbody>
</table>

**Process considerations**

**Oxygen supply**

The high \(K_{S}\) for oxygen relative to the solubility of oxygen reveals a trade-off between supplying oxygen sufficiently fast and utilizing the enzyme most efficiently.

**Enzyme stability**

The stability of enzymes is known to be affected by process related parameters such as the gas-liquid interface created upon aerating with air. This is not the case for GOase.

**Substrate and product volatility**

Oxygen supply by bubbling with air might cause volatile compounds in the reaction mixture to be stripped out of solution.

**Conclusions and further challenges**

- The high \(K_{S}\) for oxygen relative to the solubility of oxygen results in poor utilization of the enzyme at standard operating conditions. Therefore, the benefits of using enriched air or increased reactor pressure are large.

- The apparent stability of GOase towards bubbling makes the choice of aeration method less critical. However, the operating stability has to be investigated, since this might be significantly different from the stability of non-catalytically active enzyme.

- Volatility of the product is a limiting factor. This may be avoided by using alternative aeration methods, such as dead end membrane aeration. On the other hand the volatility could be utilized to selectively remove and concentration the product from the reaction mixture.

**References**