PRODUCTION OF 2,3-BUTANEDIOL FROM MOLASSES

BY

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2.6.4 pH
2.6.5 Oxygen
2.6.6 Product concentration
2.6.7 Effect of other solvents
2.6.8 Medium supplements
2.6.9 Inoculum
2.6.10 Water activity

2.7 Culture Techniques

2.8 Fed-batch Fermentation

2.9 Molasses

CHAPTER THREE

Materials and Methods

3.1 Materials

3.1.1 Strain

3.1.2 Description of Fermenter

3.2 Methods

3.2.1 Formation of Agar Slant

3.2.2 Culture medium

3.2.3 Inoculum

3.2.4 Shake Flask Study

3.2.5 Total sugar estimation

3.2.6 Biomass determination
3.2.7 Determination of 2,3-butanediol and acetoin

CHAPTER FOUR

4.0 Results and Discussion

4.1 Shake Flask Study

4.2 Fermenter runs

4.3 Fed-batch Study

CHAPTER FIVE

5.0 Conclusion and Recommendation

REFERENCE
Abstract

2,3-Butanediol is an important chemical, which is used in the manufacture of products such as synthetic rubber, printing inks, perfumes, fumigants, moistening and softening agents, explosives and plasticizers. It has been known as a bacterial fermentation product since early part of the 20th century. Klebsiella oxytoca is an organism, which can convert a variety of sugars to 2,3-butanediol. Available literature shows that principal monosaccharides of cellulosic substances as well as major hemicellulosic compounds have been used as carbon source. However, there is very little information on the application of waste material as carbon source for fermentation of butanediol.

In this work, blackstrap molasses, which is the residual liquor after crystallization of brown sugar from sugar cane juice, has been used as the carbon source in fermentation of 2,3-butanediol. Blackstrap molasses was procured from a local sugar refinery. It is readily available in Malaysia, and a high value added industrial commodity like butanediol would be a more attractive alternative to fermentation of ethanol from blackstrap molasses.

Shake flask studies were conducted to examine the viability of fermenting butanediol from blackstrap molasses. Further studies were conducted in a 5-L fermenter to perform the experiment under controlled pH, temperature, mixing
and aeration. Significant improvement in product yield was obtained with fed batch operation. The yield in the present case was 0.44 g diol per g of sugar as against the maximum value of 0.42 g diol per g of sugar reported in literature for fermentation of butanediol from blackstrap molasses.
Abstrak

2,3-butanediol adalah suatu bahan kimia penting yang digunakan dalam penghasilan getah tiruan, dakwat pencetakkan, air wangi, fumigan, bahan pelembab dan pelembut, bahan letupan, bahan pemplastik dan sebagainya. Bahan ini dikenali sebagai produk penapaian semenjak awal kurun ke-20. *Klebsiella oxytoca* adalah organisma yang dapat menukarkan berbagai jenis gula kepada 2,3-butanediol. Rujukan yang sedia ada menunjukkan bahawa monosakarida utama dari bahan selulosa (glukosa, mannosa dan galaktosa) dan juga kebanyakan sebatian hemiselulosa utama (xylosa dan arabinosa) telah digunakan sebagai sumber karbon. Walaupun demikian, maklumat mengenai penggunaan bahan sisa sebagai sumber karbon dalam penapaian butanediol adalah terhad.

Dalam kajian ini, molases hitam (sirap pekat gula) yang merupakan baki kecair selepas proses penghaburan gula perang daripada jus tebu telah digunakan sebagai sumber karbon dalam penapaian 2,3-butanediol. Molases hitam didapati daripada kilang gula tempatan. Bahan ini mudah didapati di Malaysia, dan dengan itu komoditi industri bernilai tinggi seperti butanediol akan menjadi alternatif lebih menarik daripada penapaian etanol daripada molases hitam.

Kajian kelalang goncang telah dijalankan untuk mengkaji keberkesanan penapaian butanediol daripada molases hitam. Penyelidikan seterusnya dijalankan dalam penapai 5L dibawah kawalan pH, suhu, pengadukan dan pengudaraan. Kemajuan signifikan dalam hasil produk didapati dari operasi ‘fed batch’. Dalam kes ini, hasilnya adalah 0.44 g diol setiap g gula berbanding nilai maksimum sebanyak 0.42 g diol setiap g gula yang dilapurkan dalam rujukan mengenai penapaian butanediol daripada molases hitam.
# LIST OF TABLE TITLES

<table>
<thead>
<tr>
<th>Table 2.1</th>
<th>Butanediol Isomers Produced by Various Bacteria</th>
<th>2-6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Table 2.2</td>
<td>Physical Properties of Meso Isomers</td>
<td>2-7</td>
</tr>
<tr>
<td>Table 2.3</td>
<td>Summary of Some Batch Fermenter Data</td>
<td>2-18</td>
</tr>
<tr>
<td></td>
<td>For Various Bacterial Strain and Substrates</td>
<td></td>
</tr>
<tr>
<td>Table 2.4</td>
<td>Carbohydrates Used in Diol Production</td>
<td>2-22</td>
</tr>
<tr>
<td>Table 2.5</td>
<td>Composition of Molasses</td>
<td>2-36</td>
</tr>
<tr>
<td>Table 3.1</td>
<td>Composition of the Culture Medium</td>
<td>3-5</td>
</tr>
<tr>
<td>Table 4.1</td>
<td>Conditions of Shake Flask Culture</td>
<td>4-1</td>
</tr>
<tr>
<td>Table 4.2</td>
<td>Yields and Productivities Obtained with Different</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Initial Substrate Concentration</td>
<td>4-18</td>
</tr>
</tbody>
</table>
LIST OF FIGURE CAPTIONS

Figure 1.1 Applications of 2,3-Butanediol  
Page 1-2

Figure 2.1 Classification of major Butanediol producing bacteria  
2-7

Figure 2.2 Major intermediates in conversion of a pentose or a hexose to 2,3-Butanediol  
2-11

Figure 2.3 Metabolic pathway of butanediol production from glucose  
2-12

Figure 2.4 Model for production of different stereoisomers of butanediol  
2-14

Figure 2.5 Model proposed for production of different stereoisomers of butanediol by B. Polymyxa  
2-15

Figure 2.6 Model to account for production of different stereoisomers of butanediol by K. pneumoniae  
2-15

Figure 3.1 Experimental Set-up for Fermentation  
3-3

Figure 3.2 Sugar Concentration vs Optical Density  
3-8

Figure 3.3 Peak Area in GC vs 1% 2,3-Butanediol  
3-10

Figure 3.4 Peak Area in GC vs 1.5% 2,3-Butanediol  
3-11

Figure 3.5 Peak Area in GC vs 2,3-Butanediol  
3-12

Figure 3.6 Peak Area in GC vs 1% Acetoin  
3-13

Figure 3.7 Peak Area in GC vs 1.5% Acetoin  
3-14

Figure 3.8 Peak Area in GC vs Acetoin Concentration  
3-15

Figure 4.1 2,3-Butanediol Fermentation in Shake Flask with Glucose as the Carbon Source  
4-2

Figure 4.2 2,3-Butanediol Fermentation in Shake Flask with Sucrose as the Carbon Source  
4-3

Figure 4.3 2,3-Butanediol Fermentation in Shake Flask with Total Reducing Sugar in Molasses as the Carbon Source  
4-4
Figure 4.4. Sugar and Product Concentration Vs Time with Initial Total Sugar Concentration of 25 g/L

Figure 4.5. Biomass and Dissolved Oxygen % (DO) Vs Time with Initial Total Sugar Concentration of 25 g/L

Figure 4.6. Sugar and Product Concentration Vs Time with Initial Total Sugar Concentration of 50 g/L

Figure 4.7. Biomass and Dissolved Oxygen % (DO) Vs Time with Initial Total Sugar Concentration of 50 g/L

Figure 4.8. Sugar and Product Concentration Vs Time with Initial Total Sugar Concentration of 75 g/L

Figure 4.9. Biomass and Dissolved Oxygen % (DO) Vs Time with Initial Total Sugar Concentration of 75 g/L

Figure 4.10. 2,3-Butanediol and Acetoin Vs Time with Initial Total Sugar Concentration of 75 g/L

Figure 4.11. Sugar and Product Concentration vs Time with Initial Total Sugar Concentration of 100 g/L

Figure 4.12. Biomass and Dissolved Oxygen vs Time with Initial Total Sugar Concentration of 100 g/L

Figure 4.13. Reducing Sugar and Product Concentration with Initial Total Sugar Concentration of 100 g/L (g/L)

Figure 4.14. Biomass and DO vs Time for Batch Operation with 40 g/L of Initial Sugar