Bioprocess Design for Human Hemoglobin Production in *Saccharomyces cerevisiae*

Part III – Project Analysis

Bachelor’s degree Final Project – Biotechnology

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**Introduction**

Current blood donations cannot meet the demand of blood transfusions. For that reason, it is needed another pathway to get it and solve the problem of lack of blood donations. One possibility is through recombinant protein using *Saccharomyces cerevisiae*.

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**Objective**

1. Analyze viability project in economic, environmental and social terms.
2. Get the final conclusions of the project.
3. Give some alternatives in order to improve project results.

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**Economic summary**

- **Total Capital Investment**: 19,375,000 $/kg hemoglobin
- **Operating Cost**: 5,600,000 $/year
- **Unit Production Cost**: 80,807 $/kg hemoglobin
- **Unit Production Revenue**: 1,127,500 $/kg hemoglobin
- **Revenues**: 18,945,177,000 $/year
- **NPV (at 7% interest)**: 82,347,000,000 $/year

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**Annual operating cost**

<table>
<thead>
<tr>
<th>Cost Category</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raw materials</td>
<td>18%</td>
</tr>
<tr>
<td>Consumables</td>
<td>11%</td>
</tr>
<tr>
<td>Royalties</td>
<td>62%</td>
</tr>
<tr>
<td>Others</td>
<td>7%</td>
</tr>
<tr>
<td>Storage at 4ºC</td>
<td>12%</td>
</tr>
<tr>
<td>Environmental</td>
<td>82%</td>
</tr>
</tbody>
</table>

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**Cash flow**

- **Final NVP**: 82,347,000,000 $/year

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**Alternatives**

- **Recombinant plasmid and genetically modified organism construction** → hemoglobin only represents 4% of protein production in *Saccharomyces cerevisiae*.
  - Modify recombinant plasmid (R&D)
  - Reduction of work volume → huge equipment imply more costs.
  - Increase biomass concentration (R&D)
  - Purification process → loss of hemoglobin in each step of separation and purification.
  - Recirculation
  - Culture’s medium → medium is the most sensible raw material
  - Develop new culture’s medium (R&D)

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**Conclusions**

- **PROBLEM**: Lack of blood donations
  - **SOLUTION**: Liposomes encapsulating hemoglobin
    - Economic: profitable process
    - Environmental: “friendly”
    - Social: acceptable by community
  - **x Production**: only cover 10% of current blood donations in Brazil

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**References**