Introduction

- β-Farnesene, which can be in a variety of consumer and industrial products, is currently produced by genetically modified Saccharomyces cerevisiae using sugarcane syrup [1,2].
- Sugarcane syrup contains a complex mixture of phenolic compounds derived from the sugarcane plant, which may exert antimicrobial and/or antioxidant effects, and thus influence the fermentation process [3].
- Characterization and modelling of the phenolic content variation during laboratory fermentations can help to predict the phenolic content variation during the farnesene industrial process [4].
- The aim of this work was to modulate the transfer of phenolic compounds from sugarcane syrup to the culture broth over 13 days of β-farnesene fed-batch fermentation with an Amyris engineered yeast, reproducing the industrial process conditions in 2 L bioreactors.

Results and Discussion

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Average ± SD of 2 batches</th>
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</thead>
<tbody>
<tr>
<td>TRS (g/L)</td>
<td>58.17 ± 0.20</td>
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<tr>
<td>TPC (%)</td>
<td>50.66 ± 4.16</td>
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<tr>
<td>Hydroxycinnamic acids (mg/L)</td>
<td>14.66 ± 0.46</td>
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<tr>
<td>Hydroxybenzoic acids (mg/L)</td>
<td>25.21 ± 3.03</td>
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<tr>
<td>Flavonoids (mg/L)</td>
<td>10.80 ± 1.62</td>
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Table 1 - Characterization (LC-ESI-UHR-QqTOF-MS) of sugarcane syrup used in the fed-batch fermentations.

- TPC was 50.66 mg/L, represented by 3 classes: hydroxycinnamic acids (29.2 %), hydroxybenzoic acids (49.6 %) and flavonoids (21.2 %) (Table 1).
- Among the 49 identified compounds, the most abundant one was trans-3-feruloylquinic acid, a hydroxycinnamic acid, at 7.22 mg/L.

Conclusions

- In sugarcane syrup, the most representative phenolic compound was the trans-3-feruloylquinic acid, that belongs to the hydroxycinnamic acids class.
- The decrease observed for hydroxybenzoaldehyde, protocatechuic, caffeic, ferulic and p-coumaric acids decreased after the 2nd day of fermentation, suggesting possible degradation, or yeast metabolization [5,6,7].

Phenolic compounds during fed-batch fermentation

- The concentration of most compounds increased until day 2 and then remained constant (Figure 1), reaching levels in the range of those found in the syrup.
- Some compounds (hydroxybenzaldehyde, protocatechuic, caffeic, ferulic and p-coumaric acids) decreased after the 2nd day of fermentation, suggesting possible degradation, or yeast metabolization [5,6,7].

Methodology

- The Weibull model and the theoretical mass balance successfully described the phenolic content during the fermentation (Figure 2).
- The mass balance presented a coefficient of determination (R²) of 0.88 for TPC and a root square mean error (RMSE) of 1.54. On the other hand, the Weibull model presented an R² > 0.93 and an RMSE of 1.16. Therefore, the Weibull model presented a fit closer to the experimental data.
- The mass balance data did not explain the hydroxybenzoic acids behavior by presenting a low fit (R² < 0.66) to the experimental data of this class.

References


Acknowledgements

Project co-financed by the European Regional Development Fund (ERDF), through the Operational Program for Competitiveness and Internationalization (COMPETE 2020) and Portugal 2020.