

## Optimization of low sulfur jerusalem artichoke juice for fossil fuels biodesulfurization process

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Substituting high cost thermal energy storage with biomass power plant addition to concentrate solar thermal powered electricity generation plant

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**Introduction** - Most of the world's energy is generated from the burning of fossil fuels such as oil and its derivatives. When burnt, these fuels release into the atmosphere volatile organic compounds, sulfur as sulfur dioxide (SO<sub>2</sub>) and the fine particulate matter of metal sulfates. These are pollutants which can be responsible for bronchial irritation, asthma attacks, cardio-pulmonary diseases and lung cancer mortality, and they also contribute for the occurrence of acid rains and the increase of the hole in the ozone layer. For these reasons countries around the world imposed legal maxima to sulfur concentration on fuels. Forcing companies to develop methods of removing the sulfur contained in the oil. The most common is hydrodesulfurization which employs high pressures and temperatures associated with complex metal catalysts making it extremely expensive. So, it becomes important to explore alternatives such as biodesulfurization (BDS). This process is based on the use of microorganisms for the removal of sulfur form even from the most recalcitrant compounds at atmospheric pressure and temperature, making it cheaper and more eco-friendly. However it still presents some drawbacks, such as being easily inhibited in the presence of sulfates, which have been shown to have great inhibitory effect even in amounts as low as 6 mg/l [1]. In order to further reduce the costs associated with BDS it is possible to explore alternative carbon sources, as previously shown with carob pulp syrup and recycled paper sludge [1, 2]. The main objective of this work is the optimization of sulfate removal, from Jerusalem artichoke juice, in order to use it as an alternative carbon source for BDS.

**Experimental** - The method chosen to remove the sulfate present in the juice was precipitation using BaCl<sub>2</sub>. Optimal treatment conditions were determined through a statistical design following the Doehlert distribution for two factors [3] BaCl<sub>2</sub> concentration, varying from 0.125 % to 0.625 % (w/v), and pH level of the reaction, between 5 and 9. Results were first evaluated in terms of sulfate and phosphate concentration after the treatment. And then the different juices were used as the carbon source in desulfurization assays using *Gordonia alkanivorans* strain 1B, in which growth rates, DBT consumption and 2-HBP production were used to further access their value for BDS.

**Results and Discussion** - Statistical design results showed that both factors influence the final concentration of sulfate and phosphate. Response surfaces indicate that increasing BaCl<sub>2</sub> concentration outcome in a decrease of both analyzed elements. Regarding pH levels, our results demonstrated that BaCl<sub>2</sub> had greater effects on sulfate precipitation when pH was near neutral, and that phosphate levels are reduced with increasing pH. The analysis of the data on this experimental design shows that a concentration of zero sulfates can be achieved with 0.5 – 0.55 % (w/v) BaCl<sub>2</sub> at pH 7. However the biodesulfurization assays showed that the best results were obtained when using alkaline pH, thus the optimal conditions were determined to be 0.5% (w/v) BaCl<sub>2</sub> at a pH of 8.73. These conditions presented the fastest DBT consumption and highest 2-HBP production amongst the 7 tested juices.

**Conclusion** - In conclusion results show that the use of BaCl<sub>2</sub> in optimal conditions is an effective way of reducing the sulfate concentration in Jerusalem artichoke juice to levels that allow desulfurization using the strain 1B.

**Acknowledgments:** The authors gratefully acknowledge the financial support of the project Carbon4Desulf (FCOMP-01-0124-FEDER-013932) by FCT (Fundação para a Ciência e a Tecnologia).

### References

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