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Citric Acid Production from Wood Sugars: Fermentation and LCA

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PURPOSE OF THE ABSTRACT

The need to shift from a fossil-based economy to a more sustainable circular model, forces us to review the materials being used1. Biomass is a potential renewable alternative to replace conventional fossil feedstock in the chemical industry. Currently, a few commercial bio-based chemicals are mainly produced from sugary and starchy crops. Shifting edible feedstock to lignocellulosic residues may alleviate competition for the land for biomass and food production. The citric acid (CA), a natural, non-toxic compound with three carboxylic acid groups, is found in citrus fruits and functions as a natural preservative, flavour enhancer, and natural antioxidant. Industrially produced from sucrose fermentation, it is currently extensively used in the food and pharmaceutical industries. Furthermore, it is also considered one of the potential bio-derived platform chemicals for various polymer and material science applications. Several microorganisms have been shown to produce CA; however, only the white rot fungus Aspergillus niger is currently a microorganism of choice in industry2

In this study, we aimed to compare yeast (Yarrowia lipolytica), bacterial (Bacillus licheniformis) and fungal (Aspergillus niger) strains that can produce CA by employing wood sugars as a carbon source and to develop an optimized fermentation process. It was defined that the composition of the fermentation medium strongly influences the production of CA. The up-scale process up to 1 L was also evaluated for the best-performed process with the yeast and fungi. A proper quantification of sustainability impacts is challenging due to knowledge limitations about industrial-scale performance. Nevertheless, an ex-ante life cycle assessment (LCA) of CA produced from wood sugars from the forest residues was done, implementing a methodology to scale up foreground data of emerging bio-based technologies to higher TRL. After applying the process-based calculations, screening process synergies for material, waste, and energy recovery, and estimating energy requirements, the production chain of CA was evaluated.

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FIGURES

FIGURE 1

FIGURE 2

KEYWORDS
fermentation | LCA | lignocellulose

BIBLIOGRAPHY

[1] Sheldon, R.A., ACS Sustain. Chem. Eng. 6, 4464-4480 (2018).
[2] Show P.L. et al. Front. Life Sci. 8, 271-283 (2015).