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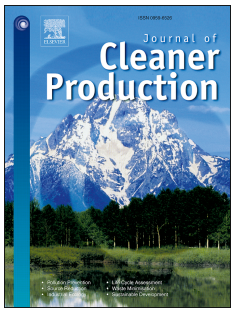

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Sara Gonzalez-Garcia, Beatriz Gullón, Sandra Rivas, Gumersindo Feijoo, Maria Teresa Moreira

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ENVIRONMENTAL PERFORMANCE OF BIOMASS REFINING INTO HIGH-ADDED VALUE COMPOUNDS

Sara Gonzalez-Garcia[1*], Beatriz Gullón[1], Sandra Rivas[2], Gumersindo Feijoo[1] and Maria Teresa Moreira[1]

[1] Department of Chemical Engineering, School of Engineering, University of Santiago de Compostela. 15782-Santiago de Compostela, Spain.

[2] Department of Chemical Engineering, University of Vigo (Campus Ourense), Spain

* Corresponding author: Tel.: +34 881816806; E-mail address: sara.gonzalez@usc.es

Abstract

Residual woody biomass from wood processing factories is commonly used as raw material for energy purposes. However, special attention is being paid to the development of biorefining systems based on lignocellulosic materials to produce high-added value bioproducts such as soluble saccharides of polymeric and oligomeric nature (POHs), cellulose, lignin, antioxidant extracts, levulinic acid or formic acid. In this study, four different potential valorisation scenaria from residual woody chips were assessed and compared from an environmental perspective using the Life Cycle Assessment methodology (cradle-to-gate approach) in order to identify the most sustainable biorefining route. Differences on these scenaria were based on different extraction routes considering always the same raw material and based on protocols performed at semi-pilot scale by the authors: two of them were mainly focused on POHs production and the remaining two, on levulinic acid. According to the results obtained, those scenaria focused on levulinic acid production reported the worst environmental performances due to the acidic treatment performed regardless the functional unit selected. Among the processes considered, purification (concentration + freeze-drying) and saccharide conversion (post-autohydrolysis) related activities were the major responsible of environmental burdens in the POHs and levulinic acid production routes, mainly due to the large energy requirements.

In addition, differences on the behaviour of environmental profiles on the scenaria based on levulinic acid production were also identified regarding the functional unit considered. Accordingly, the introduction of an additional purification step for the recovery of an antioxidant extract implied higher environmental impacts when a functional unit is based on the amount of valorised biomass. In contrast, lower environmental burdens should be obtained if the economical based functional unit is considered.

Therefore, the outcomes of the LCA study were highly dependent on the production yield of the target compounds and the protocols followed. Further research should be focused on the improvement of the extraction techniques due to the large energy and chemical requirements. LCA results could be considered as a usefulness tool for decision making strategies, specifically in biorefining systems under development.