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**Three pathways to Cleaner Platform Chemicals: Conventional, Microwave and Solar Transformation of a By-product from the Orange Juice Manufacturing Process.**

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**ABSTRACT**

For a sustainable development, chemical processes should be designed around the use of renewable raw materials (RRM). The aim of this study is using limonene, chosen as example of an industrial by-product, to prepare limonene oxides, carvone, carveol, carvacrol and terephthalic acid, all of great industrial interest, with values of one to two orders of magnitude greater than limonene and compare the results obtained with conventional, microwave or solar activation in order to decrease the environmental impact of the process. The reactions were carried using catalysts based on materials of low toxicity, i.e. iron, manganese, titania and sepiolite. A number of techniques were used to characterise the compositional, structural and textural properties of the catalysts used. The results of this research indicate that for similar conversions conventional activation requires the highest energy expenditure, related to a negative environmental impact, while the use of microwave heating greatly reduces the reaction times and solar activation proves to be a very competitive and indeed the most environmentally friendly activation method. Furthermore, orange peel oil

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