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Dehydration of sugars from grape juice waste by microwave radiation

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In Spain, grape industry is the widest, and therefore, the one that generates the larger amount of by-products. The composition depends on the grape variety used, although that is mainly water (70-80%), and sugars (20%), specifically glucose, fructose and sucrose, being the rest organic acids such as tartaric, malic or citric. The main reasons for converting those residues are their low pH and their high BDO (80-89 g/L for white juice, 78-99 g/L for red juice) and high QDO (115-117 g/L for both varieties). We propose the development of a methodology for the dehydration of the sugars in the grape juice waste water, to obtain 5-hydroxymethylfurfural (HMF) and levulic acid (LA) as main products. Those chemicals have a great interest as platform compounds, with several applications in the biofuel industry among others. Preliminary studies were carried out on the pure monosaccharides (glucose and fructose). The solution (known concentration) was introduced in a microwave vessel and sealed with a cap for under pressure work. The required heterogeneous catalyst was added (see table 1) and the reaction set at 200°C for 2-15 minutes depending on the sugar. The reaction crude was dissolved in D_2O to be analysed and quantified by NMR. The same experiments were carried out, under the optimal conditions, on several non-edible grape juices, which were provided as a similar residue to waste water sidestreams. The preliminary studies with fructose and glucose showed that the montmorillonites as catalysts offer the best results. The reactions carried out with grape juice using montmorillonite KSF were successful in obtaining HMF and LA with a fast dehydration of fructose and a moderate dehydration of glucose. Also, the catalyst is potentially recyclable which was assessed by several experiments, showing also a moderate conversion. In this work, we have been able to obtain HMF and LA as biofuel precursors using an alternative energy source and a potentially recyclable catalyst. Although it shows less efficiency on reusing, it is clean and cheap, and allows us to simply separate it from the reaction media.

Table 1: Results for the microwave conversion of 2M fructose

Exp	Catalyst	Conversion (%)	Yield HMF (%)	Yield LA (%)	Select. HMF (%)	Select. LA (%)
1	*MK10*	72.2	9.7	2.7	78.2	21.8
2	*M-KSF*	73.8	9.4	5.9	61.5	38.5
3	*Amberlyst 15*	27.7	1.6	0.2	90.0	10.0
4	*Amb15 10 min*	49.8	7.1	1.5	82.2	17.8
5	*Bentonite*	56.4	2.9	0	100	0
6	-	35.6	0.9	0	100	0

Biography

Almudena Lorente obtained her degree in Chemistry (June 2014) at the University of Castilla La Mancha. Her first contact with Organic Chemistry was in her fifth year of degree in the group of Organic Green Chemistry and Food and Agro-Industrial Waste Chemistry. Then in November 2014, she started her PhD in the same group. During these years, she has continued her training in the field of Waste and Bioeconomy. She obtained her certificate in Bioeconomy studies in September 2016.

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