1st International Electronic Conference on Catalysis Sciences

PRODUCTION OF BIOFUELS BY 5-HYDROXYMETHYLFURFURAL ETHERIFICATION USING ION-EXCHANGE RESINS AS SOLID ACID CATALYSTS

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Fossil fuels are the most important source of fuels, energy and chemicals

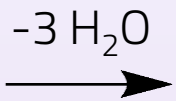
Oil refinery in Spain

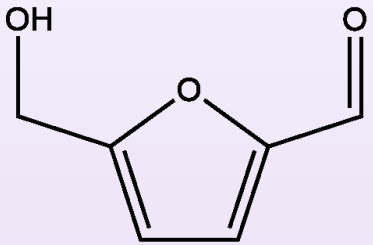
Corn Field in Liechtenstein. Corn plants are of great importance for the production of biofuels

5-ETHOXYMEHYLFURFURAL (EMF) PRODUCTION FROM HEXOSES

Hexoses

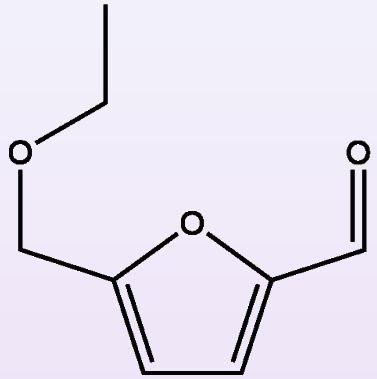
Glucose,
Fructose,
Galactose,
etc.





5-hydroxymehylfurfural (HMF)

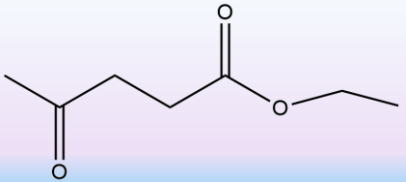
Platform chemical



5-ethoxymethylfurfural

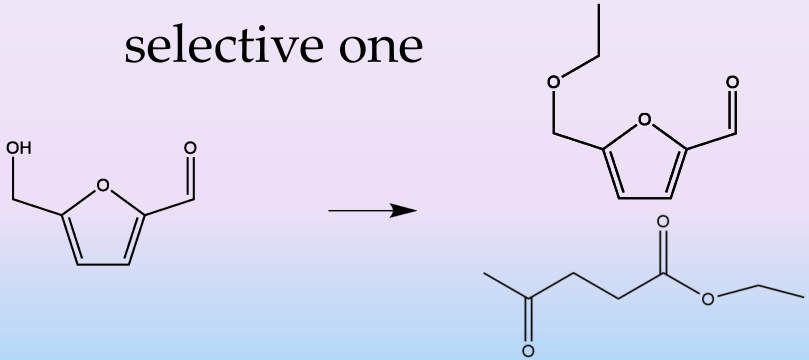
Biofuel

Ethyl levulinate (EL) ,byproduct in this process, is also an interesting biofuel additive.

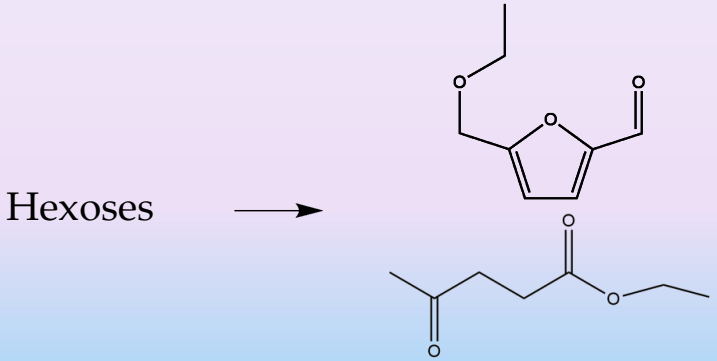


OBJECTIVES

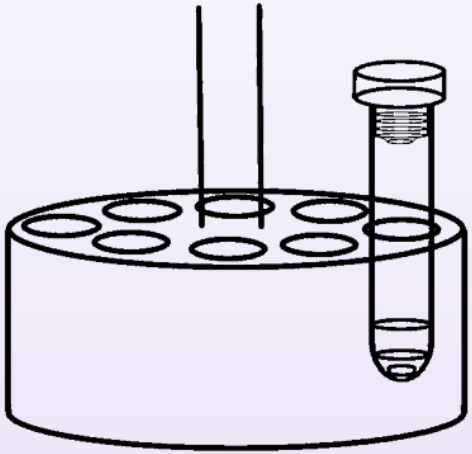
- Application of different resins in the production of EMF from HMF to identify the most active and selective one



- Application of resins to the direct dehydration and etherification of hexoses to EMF



CATALYTIC TESTS AND SAMPLE ANALYSIS



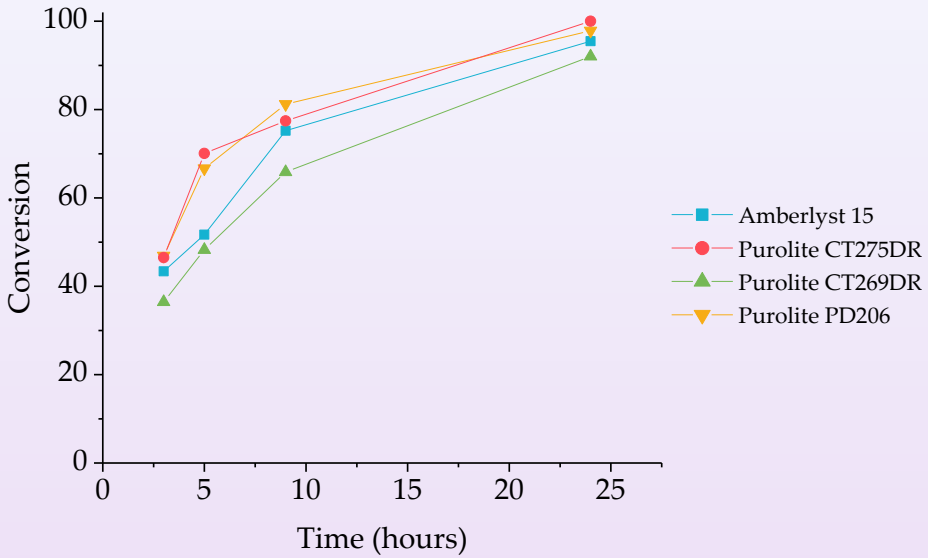
- 5 ml ethanol
- 0.05 g catalyst
- 0.1 g HMF / 0.15 g Hexose
- Reactor are degassed with nitrogen before the reaction to avoid secondary unwanted reactions

- Resulting samples were analized through High Pressure Liquid Chromatography (HPLC)
- Products were detected and quantified employing a multiwavelength detector (MD-2015) and a refractive index detector (RI-2031-PLUS)

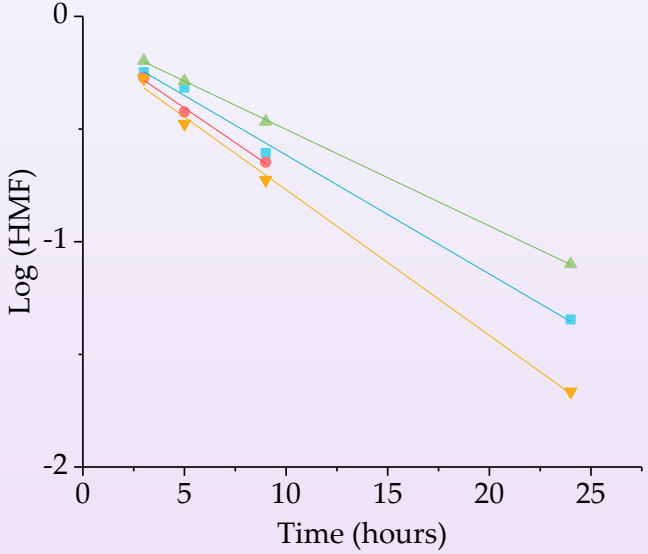
CATALYSTS CHARACTERIZATION

Catalyst Name	Resin type	Dry ionic exchange capacity ($eq \cdot kg^{-1}$)	Mesh size (μm)	BET Surface área ($m^2 \cdot g^{-1}$)
Purolite CT275DR	Macroreticular	5,2	425-1200	20-40
Purolite CT269DR	Macroreticular	5,2	425-1200	35-50
Purolite PD206	Gel	4,9	300-1200	-
Amberlyst 15	Macroreticular	>4,7	300-425	53

HMF ETHERIFICATION AT 100°C

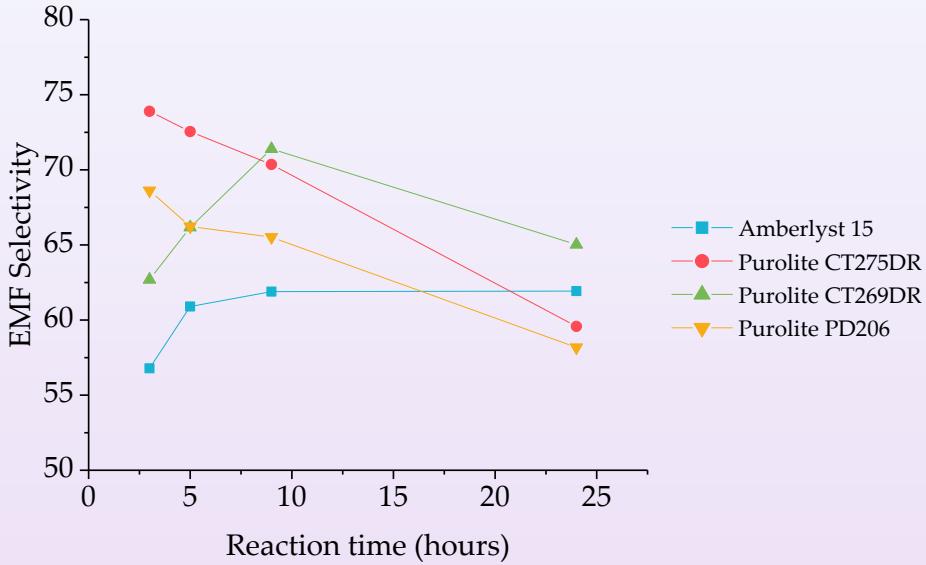


HMF conversion under 100ºC by using 0.1g HMF and 0.05g of catalyst

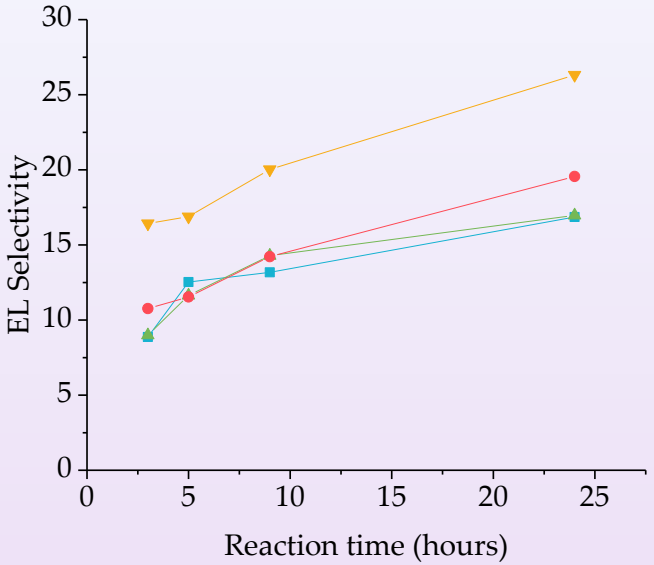


Logarithm representation of conversion. Result is akin to a first order reaction.

HMF ETHERIFICATION AT 100°C

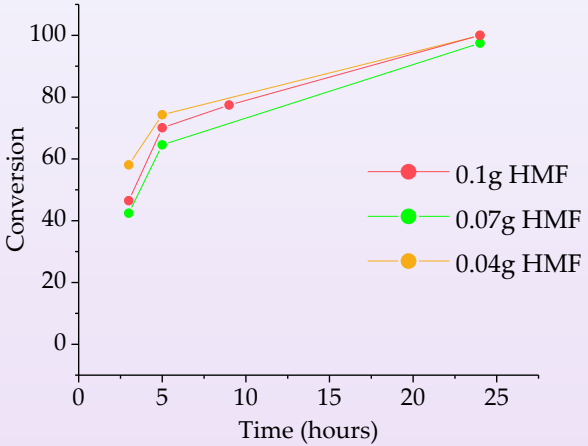


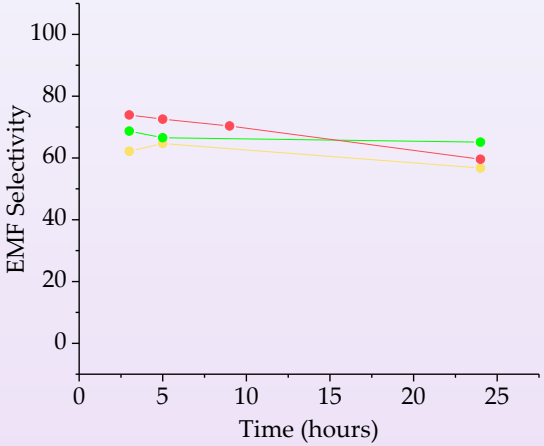
EMF selectivity at 100ºC by using 0.1g HMF and 0.05g of catalyst

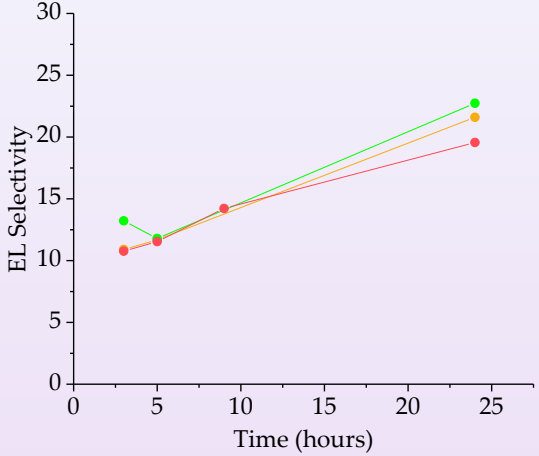


EL selectivity at 100ºC by using 0.1g HMF and 0.05g of catalyst.

HMF ETHERIFICATION VARYING HMF LOADING



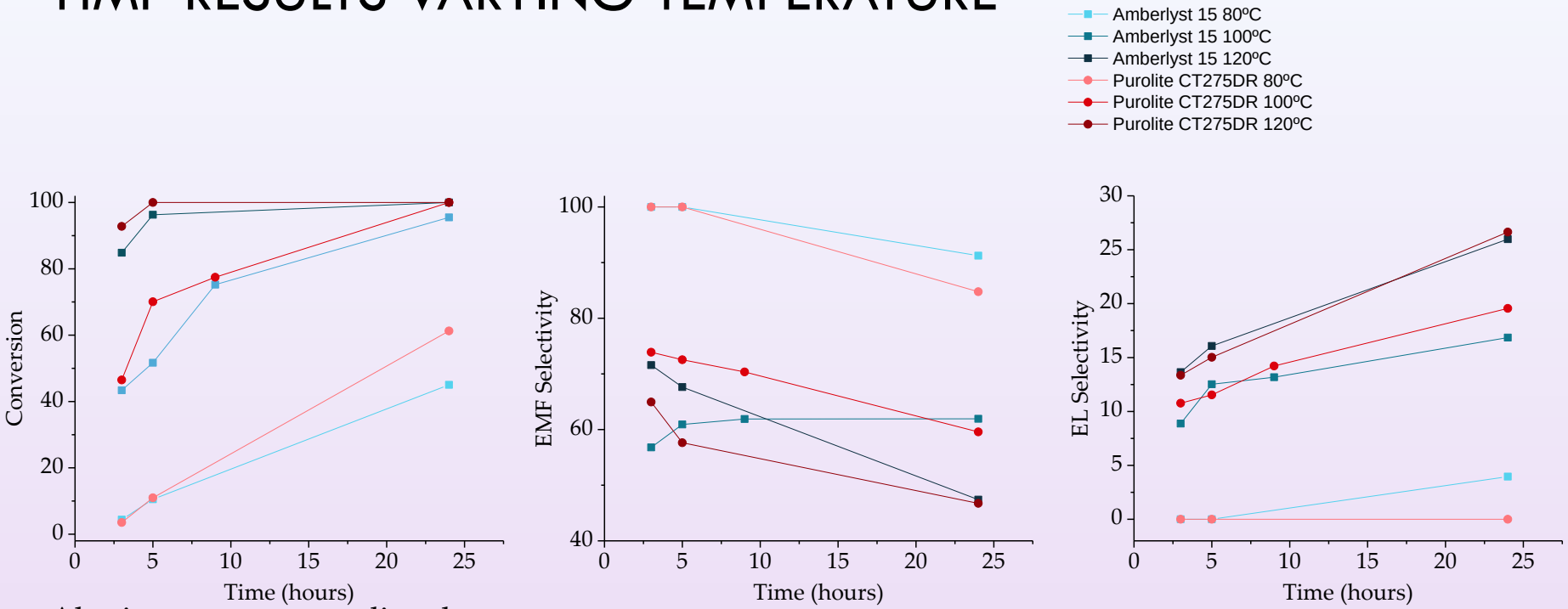




Employing different amounts of EMF does not affect conversion rate.

At the same time, different HMF loadings does not seem alter EMF or EMF results notably.

HMF RESULTS VARYING TEMPERATURE



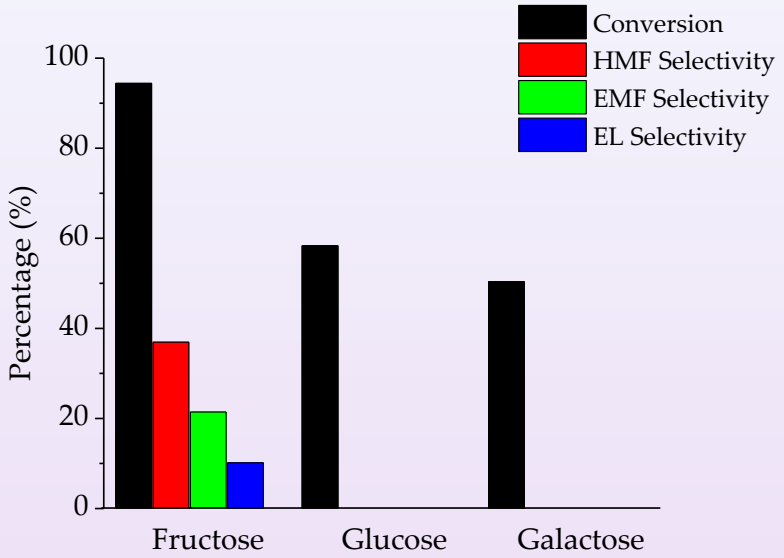
Altering temperature directly affects conversion rate.

Higher temperature favors EMF degradation causing EMF selectivity decrease. Therefore, EL selectivity increases due to furans dehydration.

HEXOSES CONVERSION AT 100°C

Hexose conversion and selectivities towards HMF, EMF and EL after 5 hours of reaction time at 100ºC.

Fructose was converted readily to HMF and its derivatives. However, glucose and galactose followed a different reaction path.



CONCLUSIONS

Several resins were assesed in ethanol for the production of EMF from HMF.

- Purolite CT275DR showed the best catalytic results.
- Although HMF loading had no effect in EMF in overall kinetics, temperature plays a major role conversion and selectivity.
- Purolite was able to convert fructose into EMF successfully, however, it was unable to dehydrate aldoses without Lewis acid sites.

THANKS FOR YOUR ATTENTION!

ACKNOWLEDGMENTS

We thank the financial support provided by the Spanish Ministry of economy and competitiveness (RTI2018-94918-B-C44), FEDER funds for a postdoctoral contract (UMA18-FEDERJA-171), and the University of Malaga.