Novel Functional Polymers From Renewable Monomers

J. Mosnáček*, M. Gurská, A. Eckstein, G. Zain, S. Lenka, J. Kollár, M. M. Puzhakkalakath, M. Danko, K. Mosnáčková, F. Pippig

[1]*Polymer Institute of the Slovak Academy of Sciences, 845 41 Bratislava, Slovakia*
* *jaroslav.mosnacek@savba.sk*

In recent years, there is increasing demand for polymer materials from renewable sources, i.e. biomass. It is related to the high global consumption of materials based on fossil resources, which are non-renewable, their quantity is limited and they are not environmentally friendly. One of the effective alternatives for creating new polymer materials is the use of renewable raw materials. The biomass is a source of a wide range of compounds that are either themselves suitable monomers or their derivatives are potential monomers for polymer chain formation. Some of the polymers can possess convenient chemical-mechanical properties, thanks to which they can able to replace synthetic polymers from fossil sources. One group of the potential monomers are furan-based compounds that contain a suitable functional group for polymerization. The most frequently used are furfural and 5-hydroxymethylfurfural. The advantage of furfural is its preparation from agricultural and forest waste, which consists in the acid-catalyzed dehydration reaction of aldoses or ketosis.[1] α-Methylene-γ-butyrolactone (MBL), known also as a Tulipalin A is an additional type of renewable monomer, and has already successfully been polymerized by various polymerizations.[2]
One part of our work deals with the preparation of three furan derivatives, which have potential to be used in the synthesis of functional polymers. These compounds represent monomers obtained from biomass as a result of the derivatization of 5-(hydroxymethyl)-furfural. Two polymerization techniques were chosen for the polymerization of these derivatives, atom transfer polymerization, ATRP, and nitroxide mediated polymerization, NMP. The derivatives containing vinyl or (meth)acrylate groups were homopolymerized or copolymerized using these polymerization techniques with the aim to prepare functional polymer with controlled molar mass and narrow distribution of molar masses (low dispersity). Second part of our work deals with the synthesis of various functional polymers from Tulipalin A and its derivatives. Thus, superabsorbent hydrogels, polymeric particles, amphiphilic polymers, polyesters as well as polyamidoamines were prepared. In addition, the amine groups at the polyamidoamines chain ends can be extended by reaction with 2,5-furandicarboxaldehyde.

Acknowledgments
The authors thank for support to FUR4Sustain project, Grant Agency VEGA through project VEGA 2/0137/23 and SRDA grant agency through project APVV-23-0534.

References
[1] Gandini A., Lacerda T.M., Polymers From Renewable Resources **2016**, 1–42, ISBN 0471238961.
[2] (a) Zain G., Bondarev D., Doháňošová J., Mosnáček J. *ChemPhotoChem*. **2019**, 3, 1138–1145; (b) Kollár J., Mrlík M., Moravčíková D., Kroneková Z., Liptaj T., Lacík I., Mosnáček J. *Macromolecules* **2016**, 49, 4047-4056; (c) Danko M., Basko M., Ďurkáčová S., Duda A., Mosnáček J. *Macromolecules*, **2018**, 51, 3582-3596; (d) Ismael I., Mrlík M., Vykydalová A., Annušová A., Halahovets Y., Mosnáček J., Danko M. *Polym. Adv. Techn.*, **2024**, 35 (4), e6404.