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Structure characterization of plant biomacromolecule as prospective therapeutic agent

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Plant biomacromolecule, namely poly[oxy-1-carboxy-2-(3,4-dihydroxyphenyl)ethylene] or poly[3-(3,4-dihydroxyphenyl)glyceric acid] (PDPGA) was detected in high-molecular fractions obtained from water extracts of different species of Boraginaceae family. According to data of ¹³C, ¹H NMR, 2D ¹H/¹³C HSQC and 2D DOSY experiments, the polyoxyethylene chain is the backbone of the polymer molecule. 3,4-Dihydroxyphenyl and carboxyl groups are regular substituents at two carbon atoms in the chain. The repeating unit of this regular polymer is 3-(3,4-dihydroxyphenyl)glyceric acid residue. Most of the carboxylic groups of PDPGA from *Anchusa italicica* and *Symphytum grandiflorum* unlike the polymer of *S. asperum*, *S. caucasicum* and *S. officinale* are methylated. The 2D DOSY experiment gave the similar diffusion coefficient for the methylated and non-methylated signals of PDPGA. This would imply a similar molecular weight for methylated and non-methylated polymers. Then basic monomeric moiety of this polymer, 3-(3,4-dihydroxyphenyl)glyceric acid (DPGA) was synthesized via Sharpless asymmetric dihydroxylation of trans-caffeic acid derivatives using an osmium catalyst. Besides, the building block for the production of derivatives of PDPGA, methyl 3-(3,4-dimethoxyphenyl)glycidate was synthesized in order to produce, in future, derivatives of synthetic analogue of natural polymer through ring-opening polymerization of 2,3-disubstituted oxirane. PDPGA is endowed with intriguing pharmacological properties as anti-complementary, antioxidant, anti-inflammatory, burn and wound healing and anticancer properties. *S. caucasicum* PDPGA and DPGA exerted anti-cancer efficacy *in vitro* and *in vivo*. However, our results showed that anticancer efficacy of PDPGA is more effective compared to its synthetic monomer. Overall, this study identifies *S. caucasicum* PDPGA as a potent agent against prostate cancer without any toxicity and supports its clinical application.

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