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Sugar based biopolymers: Poly(Sugar Acid) – Poly[3-(3,4-dihydroxyphenyl) Glyceric Acid] from medicinal plants of boraginaceae family, its synthetic analogues and therapeutic efficacy

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Abstract

Sugar based bio-polymers have widely used in medicine and pharmaceutics. According to data of liquid-state 1H, 13C NMR, 2D 1H/13C HSQC, 2D DOSY and solid-state 13C NMR spectra the main chemical constit¬uent of high molecular (>1000 kDa) water-soluble preparations from medicinal plants of Symphytum asperum, S. caucasicum, S. officinale, S. grandiflorum, Anchusa italica, Cynoglossum officinale and Borago officinalis was found to be poly[oxy-1-carboxy-2-(3,4-dihydroxyphenyl)ethylene] or poly[3-(3,4-dihydroxyphenyl)glyceric acid] (PDPGA). The polyoxyethylene chain is the backbone of this regular polymer with a residue of 3-(3,4-dihydroxyphenyl)glyceric acid as the repeating unit. PDPGA as 3,4-dihydroxyphenyl derivative of poly(2,3-glyceric acid ether) belongs to a class of poly(sugar acids). Poly(2,3-glyceric acid ether) chain is the backbone of this polymer and 3,4-dihydroxyphenyl groups are regular substituents at carbon atoms in the chain. Repeating structural unit of PDPGA contains three reactive functional groups, two phenolic hydroxyl groups in ortho-position and one carboxyl group. Oligomers of PDPGA was synthesized by "green" chemistry enzymatic ring opening polymerization of methyl 3-(3,4-dibenzyloxyphenyl)glycidate using lipase from Candida rugosa and further deprotection. Hyaluronidase (Hyal-1) degrades high molecular mass hyaluronic acid into smaller fragments which have pro-inflammatory effects. PDPGA possesses the ability to inhibit the enzymatic activity of Hyal-1 completely. Consequently, PDPGA exhibited anti-inflammatory efficacy. PDPGA exerted anticancer activity in vitro and in vivo against prostate cancer (PCA) cells via targeting androgen receptor, cell cycle arrest and apoptosis without any toxicity, together with a strong decrease in prostate specific antigen level in plasma.

Thus, PDPGA was identified as a potent agent against PCA without any toxicity.

Biography

Vakhtang Barbakadze has his expertise in isolation and structure elucidation of biologically active plant polysaccharides and polyethers. In 1978 and 1999 he has completed his PhD and DSci, respectively. He is the Head of Department of Plant Biopolymers at the Tbilisi State Medical University Institute of Pharmacochemistry. In 1996 and 2002 he has been a visiting scientist at Utrecht University (The Netherlands) by University Scholarship and The Netherlands organization for scientific research (NWO) Scholarship Scientific Program, respectively. He has published more than 100 papers in reputed journals. In 2004 he was Georgian State Prize Winner in Science and Technology.

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