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Novel phenolic biopolyether with anticancer efficacy

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The water-soluble high-molecular (>1000 kDa) fractions were isolated by ultrafiltration and gel chromatography on a Sepharose 2B column. According to IR, ^{13}C, ^{1}H NMR, 1D NOE, 2D heteronuclear $^{1}H/^{13}C$ HSQC spectral data and 2D DOSY experiment the main structural element of these preparations was found to be a regularly substituted polyoxyethelene, namely poly[oxy-1-carboxy-2-(3,4-dihydroxyphenyl)ethylene] (POCDPE). Its synthetic monomer 3-(3,4-dihydroxyphenyl)glyceric acid (DPGA) was synthesized via Sharpless asymmetric dihydroxylation (AD) of trans-caffeic acid derivatives. POCDPE is the first representative of a new class of natural regular polyethers with a 3-(3,4-dihydroxyphenyl)glyceric acid residue as the repeating unit. We found that both POCDPE and DPGA suppressed the growth and induced death in PCA cells, with comparatively lesser cytotoxicity towards non-neoplastic human prostate epithelial cells. We also found that both POCDPE and DPGA caused G1 arrest in PCA cells. In addition, POCDPE and DPGA induced apoptotic death by activating caspases, and also strongly decreased androgen receptor (AR) and prostate specific antigen (PSA) expression. However, our results clearly showed that anticancer efficacy of POCDPE is more effective compared to its synthetic monomer. In summary, our studies for the first time revealed that novel phytochemical POCDPE inhibits the growth of PCA cells both *in vitro* and *in vivo*. Results also revealed the broad spectrum effects of POCDPE on AR and PSA levels, cell cycle, and apoptosis revealing some of the plausible underlying mechanisms. In conclusion, present study is significant as we identified a natural nontoxic compound with efficacy against PCA that supports its further pre-clinical and clinical testing.

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Synthesized polymers as multifunctional fluorescent sensors for bioanalysis

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Optical sensors are important tools for cellular imaging and analysis, for probing cellular metabolism, for understanding pathways and biological and physiological processes, and for diagnosing diseases and cancers. We have used advanced polymer approach to synthesize several series of fluorescent optical sensors (pH, oxygen (O_2), potassium ion (K^+), and glucose sensors) suitable for intracellular and/or extracellular imaging and analysis. For example, we integrated individual sensors as dual sensors using polymeric synthesis techniques for simultaneous multi-parameter measurements. Of particular value for application in the complex biological environment, some of the sensors emit two or even three colors in response to the same excitation wavelength, enabling ratiometric measurements and providing superior measurement accuracy. For example, we have prepared a dual pH/O_2 sensor with three emission colors. The tri-color sensor composed of a blue emitter as an internal build-in reference probe, a green emitter as the pH probe, and a red emitter as the oxygen sensor. The build-in reference probe is unresponsive to pH or O_2. It was demonstrated that this polymer-based tri-color sensor is capable for measuring the changes of pH and oxygen concentrations in photosynthetic cyanobacteria possessing high autofluorescence. We also integrated glucose and oxygen sensor as ratiometric dual glucose/oxygen sensors for analysis of the glucose and oxygen consumption of bacterial cells and mammalian cells in real time. This dual glucose/oxygen sensor enables simultaneous measurement of glucose and oxygen, providing important information for continuous monitoring of glucose, diagnosing diabetes and hypoxia (low oxygen) related diseases and cancer, as well as the understating of biological processes of the metabolism.

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