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Photo-cross-linked poly(alkylene-co-tartrate) biodegradable matrices for implantable controlled drug delivery and other biomedical applications

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Objectives:
To investigate the synthesis and in vitro characterization of a novel family of photo-cross-linked biodegradable poly(alkylene-co-tartrate) (PAT) for the purpose of their use in implantable drug delivery and tissue engineering applications.

Methods:
PAT prepolymers were first synthesized via polycondensation reaction of L-tartaric acid with alkylene diols of varying chain lengths (C6-C12) at 130°C for two hours under nitrogen atmosphere followed by one extra hour under vacuum to form PAT prepolymers. The purified prepolymers were then acrylated using an equimolar ratio of acryloyl chloride and triethylamine. Following purification, the acrylated poly(alkylene tartrate) prepolymers (APAT) of varying degrees of acrylation were photo-cross-linked to form the elastomers. The prepared prepolymers were characterized using Proton Nuclear Magnetic Resonance (1H-NMR), Fourier transform infrared (FTIR) analysis and differential scanning calorimetry (DSC). The PAT elastomers were also subjected to sol-gel content analysis and mechanical testing. The osmotic-driven release of protein drug from those elastomers was also investigated.

Results:
1H-NMR and FTIR analysis confirmed the chemical structure and the purity of the PAT prepolymers and confirmed the existence of the acryloyl moieties at the formed chains terminals. Osmotic driven release from PAT elastomeric matrices was found to be controlled by changing the osmotic activity of the loaded drug mix as well as the degree of macromers acrylation, without altering the release kinetics. The obtained photo-cross-linked elastomers were stretchable and rubbery and swell rather than dissolve in most of organic solvents. Mechanical properties were found to be dependent on the number of methylene groups in the chain of precursor diol and the crosslinking density of the elastomeric matrices.

Conclusions:
Biodegradable, polyester matrices were successfully prepared and characterized. The family of PAT biodegradable polyesters has promising use in drug delivery and other biomedical applications including tissue engineering.