

Novel Absorbable Polymers from Functionalized Hydroquinone

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Introduction:

Commercially available bioabsorbable and biocompatible polymers such as polylactide (PLA), polyglycolide (PGA) and polycaprolactone are of great interest for biomedical applications. These polymers are synthesized by ring opening polymerization of lactone monomers such as lactide, glycolide and ϵ -caprolactone respectively. The key to the biomedical success of these polymers lies in their ability to get hydrolyzed into their α -hydroxy acid constituent such as lactic acid, glycolic acid and hydroxyhexanoic acid. These constituents are eliminated by the usual physiological metabolic pathways and hence make these polymers safe and biocompatible.

Hydroquinone is a diphenol. Diphenols are compounds containing aromatic ring(s) substituted with two hydroxyl groups. Biological activity of phenolic compounds is very well known. They occur widely in nature. Many of them exhibit anti-oxidative, anti-inflammatory, anti-mutagenic, and anti-carcinogenic properties. This makes them attractive candidates for applications in the field of nutraceuticals, pharmaceuticals and agrochemicals. Some of the examples of phenolic compounds include naphthols, flavonoids, isoflavonoids, coumarins, chromones, drugs containing phenolic groups, natural products containing phenolic groups and amino acids containing phenolic groups; Some of the examples of natural phenolics are caffeic acid, capsaicin, daidzein, and vanillin. Therefore most of the phenolics are considered to be safe and biocompatible.

The objective of the current work is to develop absorbable polymers from novel functionalized hydroquinone monomers. The resulting polymers incorporate the inherent biological properties as well as other attributes of hydroquinone. In this study, hydroquinone molecule was functionalized with safe and biocompatible molecules (e.g., glycolic acid, lactic acid, caprolactone, and p-dioxanone) to form functionalized hydroquinone monomers with tunable hydrolytic degradation profiles. The resulting functionalized hydroquinone monomers were then polymerized by condensation with diols to yield absorbable radiation stable polymers.

Results and Discussion:

Functionalization of Hydroquinone: Hydroquinone molecule (Figure 1a) was conjugated with glycolic, lactic acid and caprolactone by Williamson etherification as shown in Figures 1(b)-(d) to form novel radiation stable and hydrolysable monomers. These monomers were then subjected to condensation polymerization with ethylene glycol to yield radiation stable absorbable polymers containing phenolic molecules in the backbone as shown in figures 2 (a)-(b). The monomers as well as the

polymers in the present study will have different as well as controllable hydrolytic degradation rates. Glycolic acid functionalized hydroquinone monomers and corresponding polymers will hydrolyze faster than lactic acid and caprolactone functionalized monomers and corresponding absorbable polymers. Furthermore, using different combinations of functionalization moieties enables us to control the hydrolytic degradation rates of monomers and polymers.

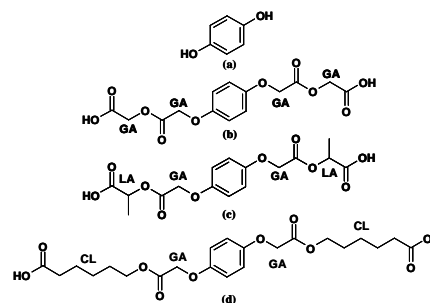


Figure 1. Functionalized hydroquinone monomers (a) hydroquinone (b) hydroquinone tetraglycolate (c) hydroquinone diglycolate dilactate and (d) hydroquinone diglycolate dicaprolactone where GA is glycolic acid, LA is lactic acid and CL symbolizes caprolactone unit

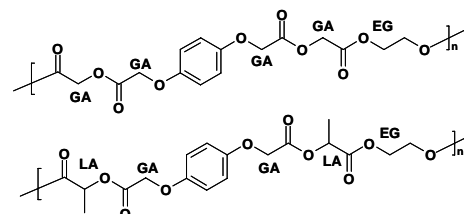


Figure 2. Absorbable polymers derived from (a) hydroquinone tetraglycolate and (b) hydroquinone diglycolate dilactate

These radiation stable absorbable polymers derived from hydroquinone will be used to prepare radiation stable absorbable sutures and coatings for implantable devices. In addition, these radiation stable absorbable polymers with tunable degradation profile can be very useful for controlled release of injectable drugs as well as in tissue engineering applications. The synthesis and characterization of novel hydrolysable functionalized hydroquinone monomers and corresponding polymers will be presented in the meeting.

References:

- (1) (a) Bezwada, Rao S., US Patent Application No. 2006/0173065 A1 (b) Bezwada, Rao S., World Patent Application No. WO2007053794A2