Bandages Coated With Organo-Selenium Inhibit Bacterial Attachment

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Statement of Purpose: It has been found that selenium can be covalently attached to an organic molecule while still retaining its ability to generate superoxide radicals ($O_2^{\cdot-}$) from the oxidation of thiols. This selenium chemistry is seen in the following equation:

$$R\text{-}Se^- + 2O_2 + 2\ R'\text{-}S\text{-}H \rightarrow R\text{-}Se^- + 2O_2^{\cdot-} + R'\text{-}S\text{-}S\text{-}G$$

The purpose of this study was to test whether it was possible to modify the surface of cellulose bandages, with a organo-selenium coating, so as to block the ability of bacteria to attach to the bandage and form a biofilm. This also needs to be done without releasing any toxic material that might harm mammalian cells. **Methods:** Selenium was covalently attached to a methacrylate. This organo-selenium methacrylate was then mixed with different amounts of the methacrylate that didn't contain selenium and attached as a coating to the surface of a cellulose bandage. The selenium-bandage was then placed over a selenium-free bandage that was inoculated with bacteria (*Staphylococcus aureus* or *Pseudomonas aeruginosa*) in a nutrient media. This is placed on an agar plate in a moist chamber at 37 degrees. After 24 hours growth in the nutrient media, the number of bacteria that attached to the selenium-bandage (colony forming units, CFU) was determined. Bacterial attachment was also evaluated by scanning electron microscopy (SEM). A dose response study to determine the amount of selenium necessary to inhibit bacterial attachment was performed by adding methacrylate containing different amounts of selenium. Toxicology studies were also performed with mammalian cells where the selenium-coated bandage was soaked for a week in the media. This media was then tested for toxicity to mammalian cells. **Results:** From dose response studies it was determined that a concentration of 0.2% selenium (~55ug Se/sq cm) in the coating was sufficient to block 100% of the bacterial attachment (both gram negative and gram positive bacteria) as determined by CFU. Ninety five% inhibition was seen at 0.05% selenium (~13ug Se/sq cm). This was in the presence of over 10^8 bacteria. SEM confirmed these results. No toxicity to mammalian cells was observed from the solution obtained by soaking of the coated bandage. **Conclusions**: Selenium can be covalently attached to a cellulose bandage material by a simple dip coating process and still retain its ability to catalyze the formation of superoxide radicals. Selenium covalently attached to a coating on a bandage has the ability to completely inhibit the attachment of 8 logs of both gram negative and gram positive bacteria (as seen by CFU and SEM assays) with no toxicity towards mammalian cells.