

# Resorbable Bioactive Antimicrobial Implant for Bone Regeneration

Karima Ahmed<sup>1</sup>, Ahmed El-Ghannam<sup>2</sup>

<sup>1</sup>Aljouf University, Saudi Arabia

<sup>2</sup>University of North Carolina at Charlotte, Charlotte 28223 USA

**Statement of Purpose:** Conventional treatment of osteomyelitis involves the repeated surgical removal of dead bone tissue coupled with repeated irrigation of the wound and prolonged systemic administration of antibiotics. Therapy of bone infections could easily last the rest of the patient's life because of the poor accessibility of the infection site by common systemically administered antibiotics. The objective of the present study is to develop a new drug delivery system based on controlled antibiotic release from a bioactive glass with an osteoconductive property.

**Methods:** 45S5 bioactive glass (BG) was modified by immersion in SBF at 37°C. Samples of modified bioactive glass (mBG) and control unmodified BG were separately immersed in 10 mg/ml nafcillin sodium for 1 h at 37°C. The amount of nafcillin adsorbed on each glass was determined using UV-Vis spectrophotometric analysis at 325 nm. The dried bioactive glass-antibiotic construct was immersed in 15 ml of SBF (pH 6) at 37°C. 50% by volume of the SBF were exchanged by equivalent volume of fresh SBF after 1, 3, 6, 24 h then after 2, 3, 9, 12, 15, 21 and 35 days. The concentration of the released drug at each time point was measured and the release kinetics was measured. The surface chemistry and morphology of BG and mBG was analyzed before and after drug loading as well as during drug release using SEM, EDX and FTIR analyses. The changes in the pH of the eluted immersion solution during the drug release were measured.

**Results:** mBG adsorbed significantly higher amount of nafcillin ( $15.445 \pm 2.98$  mg/gm) compared to BG ( $9.52 \pm 1.4$  mg/gm) ( $p < 0.05$ ). The efficiency of nafcillin loading onto mBG and BG particles was  $30.89 \pm 6\%$  and  $19.04 \pm 2.8\%$  respectively. Fig. 1 shows significant differences in the release profiles of nafcillin from BG and mBG over 35 days. During the burst release stage (0-6 h), BG released 73.5% of loaded drug while mBG released 40.24% during the burst release stage (0-3h). After 6 h, BG showed a first-order release kinetics with an average nafcillin release rate of  $0.588 \pm 0.07$   $\mu\text{g/h}$ . On the other hand the average rate of nafcillin release from mBG was  $0.766 \pm 0.08$   $\mu\text{g/h}$  during the same time period. At the end of 35 days, BG and mBG released 97.38% and 56.04% of the original loaded drug respectively.

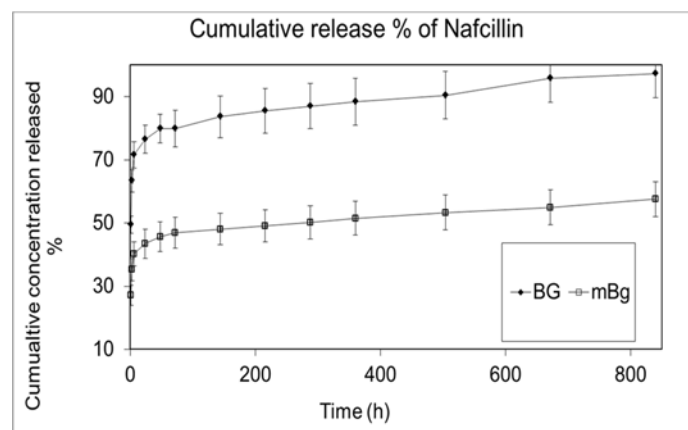


Figure 1.

The changes in the pH during drug release are shown in Figure 2.

