Compositions and Methods of Silver-Loaded Antimicrobial Biocomposites

Published date: July 28, 2017

Technology description

The Problem:

Over the past 20 years, antibiotics have been the cornerstone for infection control; however, the widespread use of antibiotics has led to the development of antibiotic resistance in bacteria and fungi. More than 700 bacterial species have been isolated and identified from the human oral cavity, most notable Streptococcus mutans. S. mutans is a key constituent of dental plaque biofilm that promotes local accumulation of microbes on the teeth and creates highly acidic microenvironments that are critical for the pathogenesis of dental caries. In addition, bacteria including S. mutans present significant challenges for dentist in post-surgery infection control. Overall, dental caries continue to be one of the most costly biofilm-dependent oral diseases worldwide, which compromise the health and well-being of children and adults alike.

Treatment and prevention of bacterial infections are not limited to oral infections or to S. mutans. Bacterial infection is a significant complicating factor associated with wounds, burns and other trauma to the body. Wound care, management and infection have an immense financial burden on health care systems worldwide. Therefore, the development of efficient antimicrobial biocomposites would provide substantial benefit to patients with post-surgical wound infection and emergency wound care.

The Technology Solution:

Researchers at the University of Tennessee are developing a composition for improved delivery of antimicrobial silver ions into an existing wound using a gelatin sponge as a scaffold. Silver and silver nanoparticles are well established for having antibacterial activity towards many bacterial species. Silver ions in the form of silver diamine fluoride, silver nitrate or silver nanoparticles were loaded into gelatin sponges with or without crosslinking with glutaraldehyde. Other delivery carriers for silver salts and/or nanoparticles can be chitosan or collagen. The silver provides the desired degree of bacterial growth inhibition by leaching out of the scaffold into the intermediate environment, where it interacts with and inhibits the growth of bacteria present therein.

The anti-bacterial capabilities of silver-loaded sponges were strongly correlated to the loading contents of silver and sources of silver. Silver diamine fluoride exhibited greater efficacy at a lower concentration compared to other sources of silver at 24 hours (Figure 2).

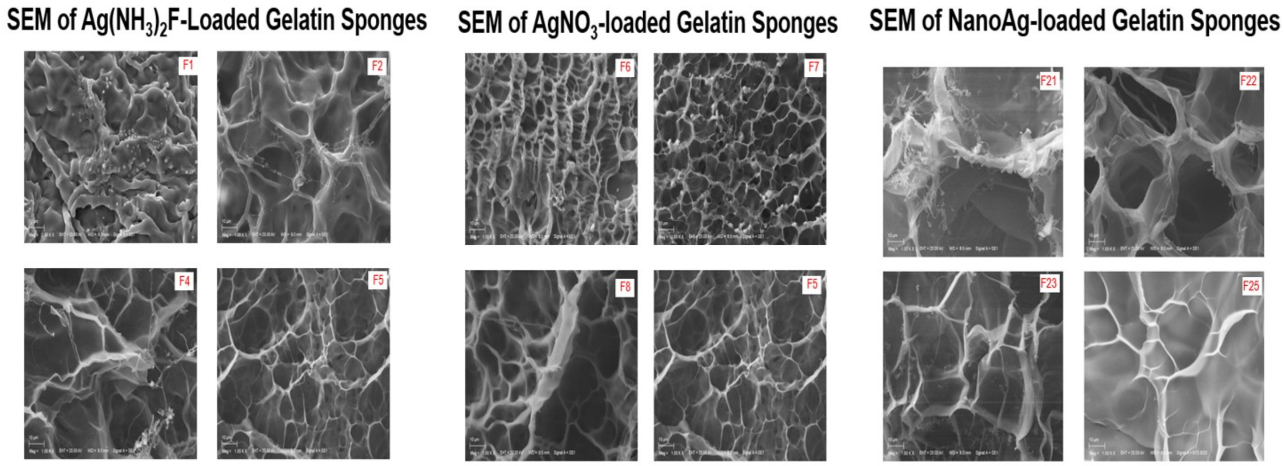
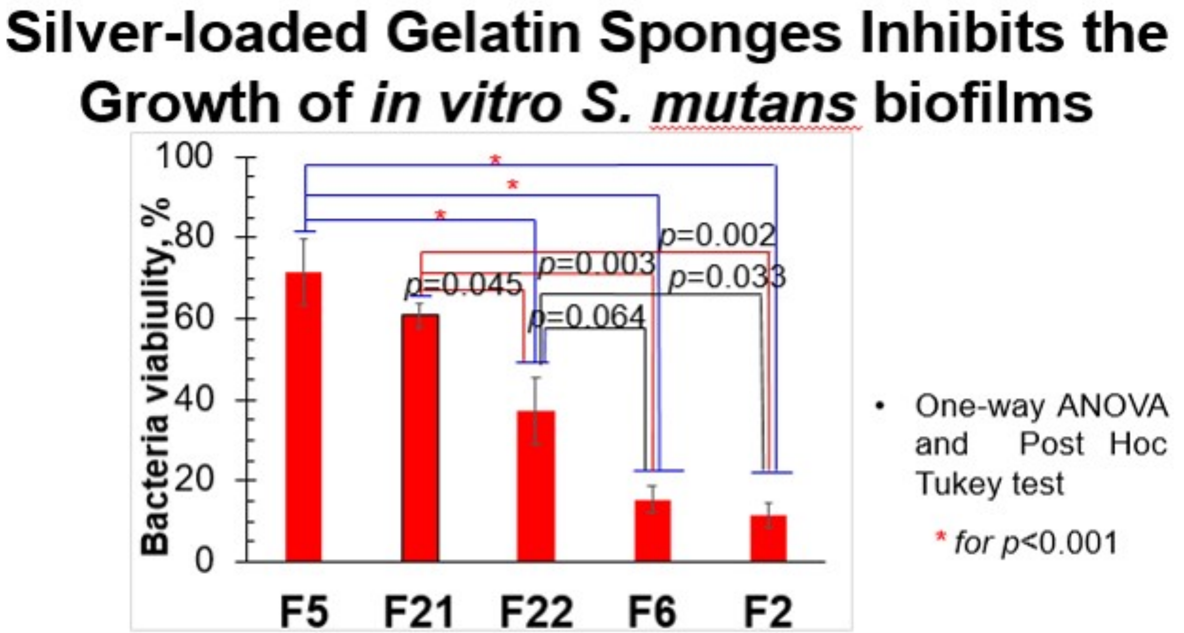


Figure 1.Photomicrographs of scanning electron microscopic (SEM) images of gelatin sponges loaded with silver diamine fluoride (left image), silver nitrate (center image) and silver nanoparticles (right image) showing porosity. The scale bars at the bottom left of each panel is 10 μM.



	Silver source	Silver, %	Crosslinked
F5	N/A	0	Yes
F21	Nano-Silver	5.16 ±0.73	Yes
F22	Nano-Silver	11.33 ±2.81	No
F6	$AgNO_3$	29.13 ±10.34	Yes
F2	$Ag(NH_3)_2F$	5.30 ±1.18	Yes

Figure 2.Inhibitory activity against S. mutans biofilm growth with silver diamine fluoride (F2), silver nitrate (F6), silver nanoparticles with crosslinking (F21) and silver nanoparticles without crosslinking (F22) gelatin sponges.

Advantages

Sustainable antimicrobial effects on S. mutans
Silver diamine fluorideexhibited greater antimicrobial effects on S. mutans at a lower concentration compared to control and other sources of silver at 24 hours
Formulations can be potentially adapted to provide antimicrobial effects for short or long term release
Applications in skin care, tooth extraction, wound dressing, dental implant and periodontal surgery

Institution

University of Tennessee

Inventors

Liang Hong
Associate Professor
Pediatric and Community Dentistry
Linfeng Wu
Postdoctoral Researcher
Pharmaceutical Sciences
Timothy Hottel
Professor
Prosthondontics
Franklin Garcia-Godoy
Executive Dean of Research
Bioscience Research

联系我们

叶先生

电 话：021-65679356

手 机：13414935137

邮 箱：yeyingsheng@zf-ym.com