

## COMPOSITE MEMBRANES FOR GUIDED PERIODONTAL TISSUE REGENERATION

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### Introduction

The development of bioactive membranes for the guided tissue regeneration (GTR) of periodontal structures is an area of increasing interest in the treatment of periodontitis, an infectious disease that destroys the tooth-attachment apparatus [1]. The GTR approach involves the placement of a barrier to exclude the epithelial and gingival tissues from the exposed root surface in order to enable the more slow-growing periodontal ligament and hard tissues to regenerate [1]. Chitosan is a biodegradable carbohydrate polymer that has been evaluated as a scaffold material for *in vitro* and *in situ* bone and periodontal tissue engineering [2]. The present study investigates the bioactivity and antibacterial properties of solvent-cast chitosan-bioactive glass composite films for potential use as GTR membranes to repair damaged periodontal structures.

### Materials and Methods

Bioactive glass (BG) and 5 wt% gallium-doped glass (BG-Ga) were prepared by the sol-gel method [3], and both glasses were ion-exchanged with silver ions (BG-Ag and BG-Ga-Ag). Chitosan and bioactive glass were blended in 1% aqueous acetic acid solution at a mass ratio of 100:35. The solutions were cast on to polycarbonate surfaces and dried in air at 60 °C. The *in vitro* bioactivity of the composite membranes was evaluated by monitoring hydroxyapatite (HA) formation on their surfaces in simulated body fluid (SBF) at 1, 3, 7 and 14 days [4]. HA was confirmed by Fourier transform infrared spectroscopy (FTIR) and scanning electron microscopy (SEM) with energy dispersive X-ray analysis (EDX). Twelve nutrient agar plates were spread with 0.2 cm<sup>3</sup> of *Escherichia coli* (1.7 × 10<sup>8</sup> CFUcm<sup>-3</sup>). Three 8 mm discs of each composite were immediately placed in the centre of each plate and the samples were incubated at 37 °C for 24 hours, after which time the zones of inhibition were measured. Each test was carried out on triplicate plates for every composite material.

### Results and Discussion

The characteristic sharp doublet of crystalline hydroxyapatite at 570 – 605 cm<sup>-1</sup> was present in the FTIR spectra of all of the composite membranes following a residence time of 3 days in SBF. The presence of hydroxyapatite was additionally confirmed by SEM and EDX.

Zone of inhibition data are listed in Table 1. These data indicate that the composites blended with the bioactive glasses, BG and BG-Ga, failed to demonstrate any antimicrobial activity against *E. coli*. Conversely, composites containing the silver-bearing glasses, BG-Ag and BG-Ga-Ag, showed clear zones of inhibition which were not significantly different ( $p = 0.445$ ).

Table 1. Zone of inhibition data for composite membranes (standard deviations in brackets)

Sample	BG	BG-Ga	BG-Ag	BG-Ga-Ag
Mean zone (mm)	0.0 ± 0.0	0.0 ± 0.0	0.27 ± 0.18	0.28 ± 0.15

### Conclusions

Antibacterial composite films can be prepared by solvent-casting mixtures of chitosan and Ag+-exchanged bioactive glass. The incorporation of 5 wt% gallium into the sol-gel-derived glass influenced neither *in vitro* bioactivity nor antimicrobial activity.

### References

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