Functionalyzed Janus Nanoparticles for Managing Dry Mouth

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Introduction

Xerostomia is defined as the subjective sensation of oral dryness. According to the ADA, it is found amongst 10 to 26% of men and 10 to 33% of women, affecting roughly 22% of the global population. The prevalence of xerostomia is particularly higher in older individuals, typically due to polypharmacy. A Reduction in salivary flow can cause difficulties in chewing, swallowing, and speaking. It can also increase dental caries, demineralization of teeth, tooth sensitivity, and oral infections. A 2011 Cochrane review found “no strong evidence” that any specific topical therapy (e.g., sprays, lozenges, mouth rinses, gels, oils, chewing gum, or toothpastes) was effective. We propose the use of Janus nanoparticles to alleviate the symptoms of dry mouth. These multi-compartmental particles could be utilized to slowly deliver an artificial saliva into the oral cavity over time (containing calcium, phosphate, pectin, aminodextran or mucin).

Methods

Mucin Janus nanoparticles, containing either pectin or aminodextran, were fabricated utilizing the process of electrohydrodynamic co-jetting. EVPOMEs, or ex-vivo produced oral mucosa equivalents, were produced by seeding 200K oral keratinocytes onto a scaffold. 50 μl of PBS. Fluorescence was assessed, both pre- and post-wash, using a SpectraMax ID3 microplate reader to produce RFU values (Relative Fluorescent Units) for each construct. SEM images of the constructs were also acquired.

Results

Mucin Janus nanoparticles containing aminodextran (272μg/ml) and pectin (145μg/ml) were successfully fabricated and tagged with BSA-488. The intensity of fluorescence was statistically significant (p<0.05) when compared to a negative control.

Application of the Janus nanoparticles to the EVPOMEs (Figure 4) showed that both pectin (2 million RFU) and aminodextran (1 million RFU) successfully adhered to the constructs when compared to the control group (500,000 RFU). Dilution of the particles resulted in a significant decrease in adhesion, suggesting concentration of the Janus nanoparticles plays a crucial role in their overall binding. Application of PBS to the bound particles resulted in reduced binding, with pectin (800,000 RFU) being less affected than aminodextran (500,000 RFU).

Conclusion

Mucin Janus nanoparticles capable of binding to EVPOME tissue constructs were successfully fabricated, with the pectin subtype displaying the most potential (2 million RFU) for binding. Particle concentration and application of PBS were significant variables influencing the rates of adhesion. The results presented here suggest that an OTC mouth rinse containing functionalyzed mucin Janus nanoparticles has the potential to adhere to the oral mucosa and relieve the symptoms associated with xerostomia.

References


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