**Evaluation of Natural Hydrogel-based Polymers for 3D Printing of an Ocular Insert: Rheology, Surface Topology, and FTIR Analysis.**

**Christopher B Olowosoke1,** Thilini Thrimawithana2, Tien Huynh1

**1**School of Science, RMIT University, PO Box 71, Bundoora, VIC 3083, Australia.

**2**School of Health and Biomedical Sciences, RMIT University, PO Box 71, Bundoora, VIC 3083, Australia.

**Background and aims.** Drug delivery to the back of the eye is challenging, and it requires expertise and frequent use of invasive injections to bypass the physical ocular barriers. Currently, solid dosage forms including inserts, implants, and contact lens are used to increase contact time and controlled drug release to the retina (1). However, synthetic polymers are commonly used, and this study aims to develop novel natural polymers as ocular inserts (OI) to enhance biocompatibility with focus on biodegradability and control release (2).

**Methods.** Formulation and 3D printing of OI using natural biodegradable polymers was conducted. Printing rheology and biocompatibility was investigated by assessing viscosity, degradation, swelling and stability using quanta SEM and FTIR analysis.

**Results.** The best formulation was with a cross-linking agent, that had 97-100 Pa.s viscosity suitable for 3D extrusion printing. The storage and loss modulus value increased between 10-100 rad/s frequency, showing gel-like viscoelastic behaviour. With the swelling test, OI maximum swelling ratio was 25 at 15 mins, but reduced to 10 after 90 mins, whereas OI degraded to 50% after 240 mins in simulated tear fluid (STF). For the surface topology, average pore size was 1-4 μm, porosity was 9-15% and smooth surface of 16 μm. The FTIR of OI showed absorbances for hydroxyl (3200-3600 cm⁻¹), alkane, alkene (2800-3000 cm⁻¹), carboxylate; asymmetric (1600-1650 cm-1), carboxylate; symmetric (1350-1450 cm⁻¹), alcohols, ethers, and esters (1000-1300 cm⁻¹) indicating biomaterial structural characteristic.

**Conclusion/Discussion.** This study shows that formulated natural hydrogel-based polymers are suitable for 3D printing of OI for therapeutic applications that is non-invasive, patient-comfort friendly, and can be self-administered without the need for removal. These findings highlight the potential of natural hydrogel in 3D-printing OI as a drug delivery system, paving the way for personalised medtech applications in ophthalmology.

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**References**

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