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Characterization of Hyaluronic Acid based suspensions added by Cellulose Nanocrystals for the Treatment of Osteoarthritis

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ABSTRACT

Osteoarthritis is a degenerative joint disease condition under which the synovial fluid loses its lubrication properties due to the oxidative degradation of hyaluronic acid (HA) present in it, by reactive oxygen species. Therefore, oxidative stability is one of the important properties to be considered while developing a HA based viscosupplement for the treatment of osteoarthritis.

This study focuses on the oxidative stability and tribological properties under mixed lubrication regime of a new suspension of cellulose nanocrystals (CNC) particles in HA at different CNC concentrations. Pin on disc tests were conducted to assess the coefficient of friction using three friction pairs including steel-steel friction pair to mimic the steel joint prosthesis, ceramic-ceramic friction pairs to mimic the ceramic based joint prosthesis and PDMS-PDMS (poly dimethyl siloxane) friction pair to mimic the human cartilage. The wear on different friction pairs after pin on disc test were characterized using scanning electron microscope and optical profilometer. The tribology test results with all the three friction pairs showed a reduction in coefficient of friction and wear with the addition of CNC particles on to the HA, due to the ability of CNC to form tribo-films between the friction pair called the mending effect. From oxidative stability assessment using in-vitro induced Weisserberger's reaction, it was observed that the samples with CNC showed almost 50% reduction in change in viscosity due to oxidative degradation as compared to the HA sample. The higher oxidative stability of samples with CNC is due to the free radical scavenging capability of CNC. The promising findings from this study will help in developing a viscosupplement with better lubrication properties and longer lasting effect due to the reduced oxidative degradation, as a treatment for osteoarthritis.

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