OGP 10-14 Peptide-loaded Mesoporous Silica Nanoparticles in the Management of Rheumatoid Arthritis.

Sani Jaysing Shinde[1], Sreekanth Pentlavalli[1], Deepak Mishra[1], Shubhamkumar Baviskar[1], Sathish Dyawanapelly[2], Justin Tian[1], Raghu Raj Singh Thakur[1]

[1]School of Pharmacy, Queen's University Belfast, BT9 7BL, Northern Ireland, United Kingdom; [2]Department of Pharmaceutical Science and Technology, Institute of Chemical Technology, Matunga, Mumbai, India

Background: Rheumatoid Arthritis (RA) is a disease that commonly affects joints in the hands, wrists, and knees. RA leads to long-term pain, inflammation, and damage of the joint tissues. The WHO estimates 0.5–1.0% of the adult population are diagnosed with RA. The target of the treatment of RA is remission or a state of low disease activity, which should be attained within 6 months. Methotrexate is the first-line therapy and should be prescribed at an optimal dose of 25 mg weekly and in combination with glucocorticoids. RA involves cartilage and bone destruction with swelling of joints accompanied by pain. Current treatment helps in postponing the diseases progression. Despite all advancement restriction on administration, frequent and long-term dosing leads to non-compliance and systemic adverse events in patients. The current study focuses to develop sustained release drug delivery technology for RA. The study intends to develop and characterize OGP 10-14 peptide-loaded silica-based nanoparticles (NPs) for the treatment of RA. OGP (10–14) peptides are the C-terminal pentapeptide which helps in proliferation, differentiation and matrix mineralization of bone cells.

Methods: OGP 10-14 peptide was synthesized using solid phase peptide synthesis. The amino acids were conjugated in the following sequence glycine, glycine, phenylalanine, glycine, tyrosine. Chemical structure was validated using NMR and FTIR. The silica NPs were characterized for their physicochemical properties. The size and morphology of NPs was characterized using BET, SEM, and TEM. Further, the particles size was measured using DLS. OGP 10-14 peptide was loaded into the hollow silica NP using solvent evaporation method and drug release study was performed.

Results: Solid-phase peptide synthesis (SPPS) was used to make osteogenic growth peptides, which were then characterized by NMR and FTIR. Aromatic proton was observed at 8-7 ppm and carboxylic acid proton was observed at 12-13 ppm. NMR revealed all amino acid protons implicated in the peptide. Further, the peak at (3300 cm^{-1}) in FTIR spectra, confirmed the formation of an amide linkage. The mean particle size of silica NPs was 670.15 nm using DLS and the effect of temperature on particles size was done by using DLS. TEM images showed that the particles size of amine-terminated mesoporous silica particles and mesoporous silica particles are 624 nm and 649 nm respectively. Results are comparable with DLS data. BET studies were performed to analyse the surface area and pore size of blank mesoporous silica and amine-terminated silica particles. The surface area was found 1105.3418 m^2 /g, and 257.8139 m^2 /g respectively.

Conclusions: OGP 10-14 Peptide successfully synthesized, which is supported with NMR and FTIR data and characterisation of blank mesoporous silica particles was done with DLS, TEM, BET, FTIR. study to create a bioconjugate of OGP 10-14 and mesoporous materials to reduce the initial bursts release is in process. OGP (10-14) is a short peptide that may be easily produced in the laboratory. Further, work will focus on the development of NIR triggered sustained-release MSPs for the treatment of RA.