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Customized polymeric nanocrystalline solid dispersion (NSD) formulation mediated delivery of quercetin for the treatment of diabetes-induces nephropathy in experimental animals

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Objectives: We report the formulation, physicochemical, morphological and biological characterization of nanocrystalline solid dispersion (NSD) formulation of quercetin for treatment of diabetes-induced nephropathy in streptozotocin-induced diabetic rat model and its relative efficacy over oral quercetin as well. Our drug in question has got potent anti-oxidant and anti-inflammatory properties but has very low aqueous solubility, hence poses a hindrance in achieving optimum systemic bioavailability and therapeutic efficacy and furthermore restricted applicability in clinical settings. Therefore, to enhance its saturation solubility and systemic bioavailability, customized nanocrystalline solid dispersion was formulated and characterized.

Methods: Nanocrystalline solid dispersion (NSD) was formulated by nanoprecipitation and solvent evaporation method, characterized by Dynamic Light Scattering (DLS) for particles size, Zeta Potential, Polydispersity Index (PDI), by Transmission Electrons Microscopy (TEM), Scanning Electron Microscopy (SEM), Atomic Force Microscopy (AFM) for size, shape and surface morphology, by Fourier-Transform Infra-Red (FTIR) spectroscopy, X-Ray Differaction Spectroscopy (XRD) Streptozotocin (55 mg/kg) i.p. single dose was used to induce diabetes in male Sprague Dawley (SD) rats. After six weeks, rats were treated with naringenin NSD at 25 and 100 mg/kg body weight orally for two weeks. Kidney functions like glomerular filtration rate, Serum creatinine and other biomarkers like β2-microglobulin, α1-microglobulin, Interleukin-18, Microalbumin, Blood Urea Nitrogen, Serum Albumin, Serum Total proteins performed. H&E and mast cell staining was done for histopathological and inflammatory alterations in kidney structure and functions.

Results: The formulated NSD was 150-250 nm in diameter, exhibited good polydispersity index, showed smooth shape and surface morphology, successfully encapsulated the drug and showed sustained drug-release pattern of quercetin. The formulated NSD successfully ameliorated inflammation and malfunctions in diabetic rat kidneys compared to normal control rats. Overall quercetin-NSD significantly protected against diabetes induced nephropathy.

Conclusions: Quercetin-NSD serves as a novel approach for treatment of diabetes-induced abnormalities in kidney structure and function. Further studies may be warranted in this regard.