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Resveratrol nanoformulation as a therapeutic in experimental acute colitis: a rat model study

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Inflammatory bowel disease (IBD) is a chronic immune-mediated disorder characterized by severe intestinal inflammation. Current treatments, including immunosuppressants and biologics, are associated with adverse effects, high costs, and patient non-responsiveness. Resveratrol, a natural polyphenol with anti-inflammatory and antioxidant properties, has demonstrated potential in IBD treatment, but its low bioavailability limits clinical application. This study investigates the therapeutic effects of resveratrol nano-emulsion (RNE), resveratrol nano-gold (RNG), and a final combination nanoformulation (RFN) in an acetic acid-induced colitis model in rats. Male Wistar rats were divided into five groups: control, colitis-induced (AA), and three treatment groups (RNE, RNG, and RFN). Colitis was induced using 4% acetic acid, and treatments were administered orally for 14 days. Disease activity index (DAI), histopathology, COX-2 expression, myeloperoxidase (MPO) activity, TNF-α levels, and oxidative stress markers were analyzed. Cellular uptake studies using flow cytometry and fluorescence microscopy were conducted, and cytotoxicity assessments were performed on Caco-2 cells. Nanoformulations significantly reduced DAI scores, rectal bleeding, and weight loss compared to the AA group ($p<0.05$). Histological examination confirmed that RNG and RFN treatment preserved crypt integrity and reduced inflammatory infiltration. COX-2 expression and MPO activity were significantly lower in the nanoformulation groups, with RNG and RFN showing the most pronounced anti-inflammatory effects ($p<0.01$). TNF-α and NO levels were reduced, while cellular uptake of nanoformulations was significantly higher than pure resveratrol. Cytotoxicity analysis confirmed minimal toxicity to normal fibroblast cells, reinforcing the safety profile of nanoformulated resveratrol. This study highlights the enhanced therapeutic efficacy of resveratrol nanoformulations in IBD treatment. Compared to pure resveratrol, RNG and RFN demonstrated superior anti-inflammatory and antioxidant effects, attributed to their improved bioavailability and targeted delivery. The significant downregulation of COX-2 and TNF-α and reduced neutrophil infiltration suggest that these nanoformulations effectively mitigate intestinal inflammation. Furthermore, the higher cellular uptake of nanoformulated resveratrol supports its potential for more effective drug delivery. The findings indicate that nano-resveratrol formulations could serve as promising alternatives to conventional IBD treatments, overcoming challenges associated with poor drug solubility and systemic side effects. Nanoformulated resveratrol, particularly RNG and RFN, demonstrated superior therapeutic effects in reducing colitis severity, inflammation, and oxidative stress. These findings highlight the potential of nano-resveratrol as a novel treatment for IBD and warrant further preclinical and clinical investigations.

Biography

Sepideh Nazeri is a Ph.D. Candidate in Medical Immunology at Tarbiat Modares University, specializing in T-cell responses, autoimmunity, and immunopharmacology. Her research focuses on novel therapies for inflammatory diseases, including an innovative thesis on 'resveratrol nanoformulations for colitis treatment'. With an M.Sc. from Tehran University of Medical Sciences and a B.Sc. in Laboratory Sciences, she has contributed to 8+ peer-reviewed publications, including first-author papers on guluronic acid (G2013) as a novel NSAID with immunomodulatory effects for rheumatoid arthritis and ankylosing spondylitis. As a Graduate Research Assistant, Sepideh excels in advanced techniques like flow cytometry, ELISA, and data analysis (PRISM, R). She has presented at international conferences (FIMSA, ESCMID) and earned multiple travel awards. Fluent in English and Persian, she also serves as a reviewer for the Immunopharmacology and Immunotoxicology Journal. Her work bridges preclinical research and clinical applications, aiming to develop targeted therapies for

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