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Development of Diosgenin-Incorporated O/W Nanoemulsion for the Transdermal Treatment of Type II Diabetes Mellitus

Abstract:

Type II diabetes mellitus (T2DM) is a chronic multifaceted metabolic condition whose deleterious effect requires urgent alternative therapeutic intervention capable of overcoming conventional oral treatment side effects. This study presents the development of a uniquely formulated Diosgenin- embedded oil-in-water (O/W) nanoemulsion (DGNe) and its transdermal antidiabetic evaluation. A rat model of T2DM was developed using male Wistar rats while DGNe was used in the transdermal treatment of infected rats. The low-energy phase inversion composition method was employed in the DGNe formulation. The effect of STZ and DGNe on rats were evaluated. Routine histopathological examination of the skin, pancreatic tissues, liver, heart and kidney including immunohistochemical expression of insulin receptor and sodium-glucose transporter (SGLT2) were studied. The characteristic surface morphology of DGNe was determined using SEM and FESEM. The functional stability of the formulated DGNe was characterized using FTIR and DLS techniques. An almost spherical nanoemulsion matrix of the dispersed diosgenin was revealed and the DLS analysis indicated particles with size ranging from 92 – 265 nm with a PDI between 0.01 - 0.40. In-vitro drug release studies indicated a slow, continuous and sustained release of drug from 0.5 to 15 h period while signs of skin irritation from DGNe were negligible. Microscopic histopathological reports showed alterations in the physical architecture of examined tissues of diabetic rats. Elevated blood glucose concentration and HbA1c level in STZ-induced rats were significantly reduced in DGNe–treated rats. This study showed the potential of nanoemulsion as an efficient drug reservoir and vehicle, capable of promoting the transdermal delivery of a phytodrug towards treating T2DM.

Biography

Oyesolape Basirat Akinsipo is an accomplished researcher and academic with a Ph.D. in Industrial Chemistry, specializing in Green and Medical Nanotechnology. She is a Senior Lecturer in the Department of Chemical Sciences at Tai Solarin University of Education, Ogun State, Nigeria. Her academic journey has been marked by international recognition, including the prestigious DBT-TWAS Postgraduate Fellowship (2018), which enabled her research residency at Amity University, India. Akinsipo's work has led to the development of innovative, eco-friendly solutions, earning her both national and international patents. In 2023, she was awarded the Green Chemistry Challenge Award Grant by Millipore Sigma, in recognition of her contributions to sustainable chemistry. She is the founder of MoreGreen Plus, a platform promoting green chemistry and nanotechnology education and research. Her expertise extends beyond research, as she actively supports capacity building in science through training, research commercialization, and mentorship programs. She serves as an advisor and program manager for emerging fellowship schemes that empower early-career researchers. Akinsipo also co-hosts global webinars such as the Green Chemistry Connections, fostering international collaboration and knowledge exchange in green chemistry and nanoscience.