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Brief summary of the work

α-Lipoic acid (LA, 6,8-dithiooctanoic acid) is organosulfur compound, belongs to B-vitamin family and distinguished by its potent antioxidant properties. Indeed it is known as universal antioxidant due to its ability to neutralize free radicals through both direct mechanisms (such as direct scavenging of radical species) and indirect mechanisms (including the activation of antioxidant enzyme transcription via nuclear pathways). Additionally, LA has demonstrated efficacy in the prevention and treatment of various conditions, including hepatic, cardiovascular, diabetic, and neurodegenerative diseases, notably Alzheimer's disease. A deficiency in LA has also been implicated in the pathogenesis of early infantile epileptic encephalopathy. Despite its considerable therapeutic potential, LA's clinical application is hindered by several challenges, including poor aqueous solubility, thermal instability, and limited bioavailability (approximately 30%).

To address these limitations, this work involved the exploration of three innovative formulation strategies: polymer-drug conjugation, cyclodextrin inclusion complexes combined with nanofiber technology, and solid dispersion techniques. The first strategy involves the synthesis of a lipoic acid-polymer conjugate *via* carbodiimide coupling to enhance its antiepileptic efficacy. In the second approach, lipoic acid-cyclodextrin inclusion complex is formulated and encapsulated within nanofibers to develop patient-friendly, orally disintegrating delivery systems (ODDSs) without the use of toxic organic solvents. The final strategy focuses on the solid dispersion of lipoic acid to improve its therapeutic efficacy. The outcomes of this research offer promising avenues for the efficient delivery of lipoic acid, advancing its pharmacological potential from experimental settings to clinical application.

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