

Chapter 11: AI-Driven Approaches in Liposomal Drug Delivery to Improve Drug Bioavailability

Patel Sofiya Iqbal¹ Vaishali Sharma, Dhananjay Meshram

Pioneer Pharmacy College, Nr. Ajwa Crossing, Sayajipura, Vadodara-390019, Gujarat, India.

Abstract: Most of the promising drugs do not show their utmost potential as the body is unable to absorb such drugs and thus poor bioavailability occurs. The smart solution is liposomes, which are small spherical vesicles composed of the phospholipid bilayers. They have the ability to transport water and fat soluble drugs, shield them against degradation and deliver them in a controlled manner. Liposomes also decrease side effects and increase effectiveness of treatments because they can be used to target certain tissues. However, it is not quite simple to design the ideal liposome. Conventional methods usually involve trial and error, which may be both expensive and time consuming as well as random. It is at this point that artificial intelligence (AI) is altering the game. Using the computational models and machine learning, scientists can now forecast the interaction of drugs with liposomes, select the most appropriate formulation strategies and enhance bioavailability more quickly and cost-effectively. This review gathers the up-to-date information about liposomal drug delivery, and AI has become increasingly prominent. It discusses AI and liposomes in their combination, their potential and the future, presenting how AI and liposomes are coming together to make smarter drug delivery systems.

Keywords: Artificial intelligence (AI), Liposome, drug delivery, bioavailability

11.1 Introduction

Liposomes have been a cornerstone of drug delivery and nanomedicine for over five decades, recognized for their unique ability to encapsulate a wide variety of therapeutic agents within their biocompatible lipid bilayer structure [1]. Their proven capacity to enhance drug solubility, prolong circulation time, and reduce systemic toxicity has led to the successful clinical translation of numerous liposomal formulations. However, the conventional methods of liposome development are often empirical, time-consuming, and can result in formulations with suboptimal physicochemical properties, hindering their full therapeutic potential [2]. To address these limitations, the field is undergoing a paradigm shift driven by the integration of Artificial Intelligence (AI) and Machine Learning (ML). These computational approaches are enabling the rational design and optimization of liposomes, allowing for the precise prediction of key formulation