Chapter 4

Lipid Selection and Drug Compatibility

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Abstract

Lipid-loaded drug delivery vehicles such as liposomes, lipid nanoparticles (LNPs) and emulsions hold great promise towards solving some of the problems related to drug solubility, stability, and targeted drug delivery since these delivery vehicles are lipid-based. Lipids preserve both water based and fat based drugs and their amphiphillic nature increases their bioavailabilities and can provide controlled or sustained release. Effective formulations of lipid-based formulations require the interaction of the drug and the lipid matrix to be compatible; compatibility affects the drug loading, the release kinetics, and stability, besides the bioavailability of the drug. This chapter examines how lipids may be used in drug delivery and in what criteria a lipid should be chosen, and how the lipid preparations may be adjusted to achieve a better therapeutic effect. Some of the considerations such as drug-lipid interactions, phase behavior, and drug biocompatibility among others are addressed to show the significance of using the appropriate lipid when necessary to produce intended therapeutic effects. Further, the approaches that could elevate lipid-drug compatibility like lipid modification and lipid mixing are also presented, as well as the use of the systems in the development of cancer treatment, gene, and vaccine delivery.

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1. INTRODUCTION

Development of the drug delivery system that not only improves the therapeutic activity of a drug by providing desired form of drug delivery but also allows the drug to be stable, soluble and selective to a particular tissue or a cell is one of the greatest challenges in the field of pharmaceutical development. Lipid formulations, such as liposomes, lipid nanoparticle (LNPs), and emulsions have developed as effective mechanisms to respond to most of these issues. Lipids are the perfect candidates to the development of complex drug carriers because of their versatility, being amphiphilic molecules, consisting of a hydrophobic (water-repelling) and a hydrophilic (water-attracting) moiety. The major lipid role in influencing the drug properties is pharmacokinetics and pharmacodynamics. The PK term is used to refer to absorption, distribution, metabolism and excretion of a drug, whilst the pharmacodynamics refers to the drug biochemical and physiological effects. Both processes can occur considerably better in the presence of lipids, micro-emulsions, because of the lipid-based forming of structured systems, bilayers, vesicles, and micelles, can effectively enhance the solubility and stability of drugs thus increasing their bioavailability, and targeted controlled or sustained drug delivery. This is especially crucial to drugs that are sparingly soluble in water or drugs whose half-life is short [1].

To ensure such drugs reach their intended target site and perform the intended therapeutic effect, the drug delivery system must be able to surpass bodily obstacles that are faced by such drugs, i.e. degrading enzymes, immune cell that can identify and possibly eliminate the drug coupled with physical blockages in form of cell membranes. The two challenges can be dealt using lipid-based systems, i.e., by enclosing the drugs within lipid matrices and prevent degradation and regulate releasing. Moreover, the lipids may increase the specificity of the