Chapter 3

Physicochemical Properties of Solid Lipid Nanoparticles

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Abstract

Solid Lipid Nanoparticles (SLNs) are characterized by various physicochemical properties that influence their behavior and effectiveness, particularly in drug delivery and other applications. Characteristics such as encapsulation efficiency, surface morphology, zeta potential, crystallinity, and particle size and dispersion are included in this list. Some parameters, such the lipid content and the techniques of manufacture, impact the stability and drug release profile of SLNs. Ideal SLN formulations to address therapeutic demands can only be achieved by a thorough comprehension of these characteristics. In terms of stability, bioavailability, and targeted medication administration, SLN size is a critical performance component. Morphology of SLNs is often studied using microscopy methods like Scanning Electron Microscopy (SEM) and Transmission Electron Microscopy (TEM). Importantly, zeta potential shows how charged the surface of SLNs is. A greater zeta potential is associated with better stability in SLNs because electrostatic repulsion between particles makes clumping less likely. A SLN's crystallinity, or the organized organization of its lipids, may have a major impact on the drug release characteristics and physical stability of the nanoparticle. When testing for crystallinity in SLNs, one frequent method

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is differential scanning calorimetry (DSC). It is crucial that SLN formulations be stable in order to guarantee their effectiveness and safety during storage and use. Lipid composition, surfactant type, and environmental conditions (e.g., temperature, humidity) all affect SLN stability.

Keywords: Solid Lipid Nanoparticles, Physiochemical Properties, Characterization of SLNs, Particle Size and Size Distribution, Surface Morphology, Zeta Potential and Crystallinity.

1. INTRODUCTION

The pharmaceutical sciences have been profoundly affected by the dramatic uptick in the creation of drug delivery systems based on nanotechnology in the last few decades. More than 40% of all medicines on the market are hydrophobic, and they are crucial for the delivery of these drugs. One major constraint that affects medication release and bioavailability is the hydrophobic medicines' low water solubility. But this problem may be solved by using drug delivery devices based on nanotechnology [1]. Drug stability, enzyme degradation, circulation time, and target cell absorption are all improved when medicines are incorporated into nanoparticles (NPs), which in turn increases the overall efficacy and safety. A new method of medication administration called solid lipid nanoparticles (SLNs) has been developed in the last 20 years. This technology has the potential to enhance the therapeutic benefits, bioavailability, and safety of a diverse array of medications [2-3]. A substantial quantity of research has been conducted on them for the purpose of delivering drugs through oral, parenteral, transdermal, intranasal, ophthalmic, and pulmonary routes. The management of a diverse array of diseases will be enhanced by the availability of SLNs for clinical use in the near future, which will be achieved through a variety of administration methods.

2. PHYSIOCHEMICAL FEATURES OF SLNs

2.1 Particle size distribution

One of the most important factors influencing the total effectiveness of solid lipid nanoparticles (SLNs) is their quantum size. Multiple factors are