Lyophilized Biologics

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Lyophilized Formulations

Delicate three-dimensional structures essential for the biological activities of proteins are often susceptible to various modes of denaturation or degradation when they are isolated and prepared for therapeutic purposes. Upon exposure to routine manufacturing processes, storage, and transportation, proteins experience physicochemical changes, including microscopic changes at the level of amino acid side chains (e.g., oxidation, deamidation, or isomerizations) to macroscopic changes, like structural changes, oligomerization, aggregation, or precipitation [2, 3, 8, 9, 16, 22, 24]. Undesirable consequences associated with degradation products include loss of biological activities and undesirable immune responses [17, 20, 25]. Antibodies generated during an immune response can further affect therapeutic potential, as neutralizing antibodies can compromise naturally existing proteins while nonneutralizing antibodies can affect therapeutic protein availability.

For the successful introduction of biopharmaceuticals in the past two to three decades, advancement in stability indicating analytical methods has been instrumental in delivering good quality protein pharmaceuticals with excellent stability profiles [1, 12, 14, 23, 26].

Among the many different and practical solutions for maintaining the integrity of biopharmaceuticals until sufficient expiry, lyophilization has been the most extensively researched [4, 5, 21]. This is primarily due to the high stability provided by a dried powder formulation. Lyophilized formulations generally offer additional advantages, such as a unique way of achieving sufficient expiry for intrinsically labile proteins, potential stability at ambient temperatures, removal of water as a reactant or media for undesirable degradations, and inhibition of autolysis from

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