

What is claimed is:

1. A method of preparing a lyophilized cake, comprising:
preparing a formulation, wherein the formulation comprises at least one solvent molecule and a peptide or protein;
subjecting the formulation to lyophilization to obtain the lyophilized cake, including:
placing the formulation in a chamber of a freeze-dryer,
freezing the formulation,
conducting first drying on the formulation to remove the at least one frozen solvent molecule by sublimation, wherein the first drying is conducted at a shelf temperature of the freeze-dryer that is equal to or below about 0 °C, and
conducting second drying on the formulation to remove the at least one solvent molecule to obtain a target weight percentage of the at least one solvent molecule in the lyophilized cake, wherein the second drying is conducted at the shelf temperature of the freeze-dryer that is equal to or below 0 °C.
2. The method of claim 1, wherein the target weight percentage of the at least one solvent molecule in the lyophilized cake is controlled by the shelf temperature of the freeze-dryer for the second drying with a controlled drying rate.
3. The method of claim 1, wherein the target weight percentage of the at least one solvent molecule in the lyophilized cake is controlled by a duration time for the second drying.
4. The method of claim 1, wherein the shelf temperature of the freeze-dryer for the second drying is equal to or slightly higher than the shelf temperature of the freeze-dryer for the first drying.
5. The method of claim 1, wherein the shelf temperature of the freeze-dryer for the second drying is same as the shelf temperature of the freeze-dryer for the first drying.
6. The method of claim 1, wherein the shelf temperature of the freeze-dryer for the second drying is higher than the shelf temperature of the freeze-dryer for the first drying.

7. The method of claim 1, wherein the shelf temperature of the freeze-dryer for the second drying is lower than the shelf temperature of the freeze-dryer for the first drying.
8. The method of claim 1, wherein the target weight percentage of the at least one solvent molecule in the lyophilized cake is about 3-5%, about 4% or about 4.5%.
9. The method of claim 1, wherein the peptide or protein is an antibody, an antibody fragment, a Fab region of an antibody, an antibody-drug conjugate, a fusion protein, a protein pharmaceutical product or a drug.
10. The method of claim 1, wherein the lyophilized cake is stable under the storage condition at room temperature or has improved stability for refrigeration storage.
11. The method of claim 1, the at least one solvent molecule is a water molecule.
12. The method of claim 1 further comprising determining an ending of the first drying based on a change of a pressure in the chamber of the freeze-dryer.
13. The method of claim 1, wherein a temperature of the lyophilized cake is below a collapse temperature of the lyophilized cake in the first drying.
14. The method of claim 1, wherein the formulation further comprises a buffer, an excipient, a stabilizer, a cryo-protectant, a bulking agent, a plasticizer, or a combination thereof.
15. The method of claim 14, wherein the buffer comprises acetate and/or histidine hydrochloride.
16. The method of claim 14, wherein the buffer has a pH value of about 5.3 or about 6.
17. The method of claim 14, wherein the excipient is polysorbate 80.
18. The method of claim 14, wherein the stabilizer is sucrose, wherein the ratio of sucrose to the peptide or protein is about 1:1, about 3:1, about 10:1, or about from 1:1 to 10:1.
19. The method of claim 14, wherein the stabilizer is polyol, sucrose, mannitol, trehalose, sorbitol, amino acid, or a combination thereof.
20. The method of claim 14, wherein the cryo-protectant is surfactant, sugar, salt, amino acid, or a combination thereof.