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**Novel analytical methods to assess the chemical and physical properties of liposomes**

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**Abstract**

Liposomes are used in commercial pharmaceutical formulations (PFs) and dietary supplements (DSs) as a carrier vehicle to protect the active ingredient from degradation and to increase the half-life of the injectable. Even as the commercialization of liposomal products has rapidly increased, characterization methodologies to evaluate physical and chemical properties of the liposomal products have not been well-established. Herein we develop rapid methodologies to evaluate chemical and selected physical properties of liposomal formulations. Chemical properties of liposomes are determined by their lipid composition. The lipid composition is evaluated by first screening of the lipids present in the sample using HPLC-ELSD followed by HPLC-MSMS analysis with high mass accuracy (<5 ppm), fragmentation pattern and lipid structure databases searching. Physical properties such as particle size and size distribution were investigated using Tunable Resistive Pulse Sensing (TRPS). The developed methods were used to analyze commercially available PFs and DSs. As results, PFs contain distinct number of lipids as indicated by the manufacture, but DSs were more complicated containing a large number of lipids belonging to different sub-classes. Commercially available liposomes have particles with wide size distribution based on size measurements performed by TRPS. The high mass accuracy as well as identification lipids using multiple fragment ions aided to accurately identify the lipids and differentiate them from other lipophilic molecules. The developed analytical methodologies were successfully adapted to measure the physiochemical properties of commercial liposomes.

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