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Janoff et al.

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[54] **DEHYDRATED LIPOSOMES**

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[52] U.S. Cl. 424/450

[58] Field of Search 264/4.1, 4.3, 4.6; 428/402.2; 424/417, 450

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[57] **ABSTRACT**

Dehydrated liposomes are prepared by drying liposome preparations under reduced pressure in the presence of one or more protective sugars, e.g., the disaccharides trehalose and sucrose. Preferably, the protective sugars are present at both the inside and outside surfaces of the liposome membranes. Freezing of the liposome preparation prior to dehydration is optional. Alternatively, the protective sugar can be omitted if: (1) the liposomes are of the type which have multiple lipid layers; (2) the dehydration is done without prior freezing; and (3) the dehydration is performed to an end point which results in sufficient water being left in the preparation (e.g., at least 12 moles water/mole lipid) so that the integrity of a substantial portion of the multiple lipid layers is retained upon rehydration. Concentration gradients capable of generating transmembrane potentials can be created across the liposome membranes either before or after dehydration, and the transmembrane potentials resulting from these gradients can be used to load charged materials, e.g., drugs, into the liposomes.

9 Claims, 9 Drawing Sheets