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Liquid crystalline phase metastability of phosphatidylglycerols

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Abstract

Aqueous dispersions of dilauroylphosphatidylglycerol (DLPG) and dimyristoylphosphatidylglycerol (DMPG) form stable subgel and liquid crystalline lamellar phases, L_c and L_α, and also metastable gel phases, $L_{\beta'}$ and $P_{\beta'}$, at physiologically relevant conditions (neutral pH, < 0.2 M salt). The metastable gel phase $L_{\beta'}$ relaxes to the stable subgel phase upon low-temperature storage, with at least one metastable intermediate in the case of DMPG. The gel–liquid crystalline phase transition takes place at temperature with 15–30°C lower as compared to that of the subgel–liquid crystalline phase transition in these phosphatidylglycerols. Therefore, the lamellar liquid crystalline phase L_α is expected to exhibit metastability in the temperature range between the gel–L_α and subgel–L_α phase transitions, in which the subgel phase is the equilibrium one. Here we demonstrate by using differential scanning calorimetry that crystallisation from the liquid crystalline phase in this temperature interval takes place in DMPG and DLPG. The kinetics of the observed L_α-to-L_c phase relaxation is sensitive to the thermal prehistory of the lipid dispersion. This is possibly related to the different morphologies of the lipid aggregates in the subgel and liquid crystalline phases (Epand et al., 1992) and the slow interconversion between them. © 1997 Elsevier Science Ireland Ltd.

Keywords: Phase transition; Polymorphism; Liposomes; Lipid membranes; DSC

1. Introduction

Aqueous dispersions of the anionic saturated phosphatidylglycerols (PG) at physiologically relevant conditions (neutral pH, < 0.2 M salt) exhibit phase transitions similar to those of the zwitterionic phosphatidylcholines with the same acyl chains (NIST Standard Reference Database 34, 1994; LIPIDAT (http://www.lipidat.chemistry.ohio-state.edu); Zhang et al., 1997). Thus, dilauroylphosphatidylglycerol (DLPG) dispersions display a rippled gel—lamellar liquid crystalline ($P_{\beta'}$-L_α) transition at temperature close to 0°C

Abbreviations: DMPG, 1,2-dimyristoyl-*sn*-glycero-3-phosphoglycerol; DLPG, 1,2-dilauroyl-*sn*-glycero-3-phosphoglycerol; DSC, differential scanning calorimetry.

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