

TA NO. 1 APR.1977

DSC Measurements of Phase Transition of Lipid

1. Introduction

The major components of biomembrane are protein and lipid, and phospholipid is typical lipid making up biomembrane. Dipalmitoyl lecithin (hereafter abbreviated as DPL) is a typical phospholipid, which is a synthetic lecithin with a fatty acid chain with 16 carbon molecules. When DPL ribosome is heated from room temperature, a phase transition takes place at about 41°C. This phase transition is considered to be the transition from the state in which the fatty acid chain of DPL is stretched along a straight line to the state in the liquid form, its head portion (hydrophilic) maintains long-range order, and is considered to be in a state of liquid crystal. (Figure 1)

When this type of substance exists in nature, it is usually in the form of a solution with low concentration. Thus the thermal analysis of such a solution requires an instrument that is capable of measurement at low concentration.

In this brief, the heat of phase transition of dipalmitoyl lecithin was measured by the DSC.

2. Experiment

The concentration of DPL measured in this experiment ranged from 3.67mg/ml (0.367w%) to 36.7mg/ml (3.67w%). The sample weight was 60mg. The temperature was raised from 20°C to 160°C at 0.6°C/min. The sample was sealed in a hermetically sealed silver container so that the solvent would not evaporate at all.

3. Measurements and Results

Figure 2 and 3 shows the measurement results of samples with concentrations of 14.68mg/ml and 3.67mg/ml, respectively. The temperature of phase transition and that of the small pre-transition agree well with the literature values ^{1,2)}.

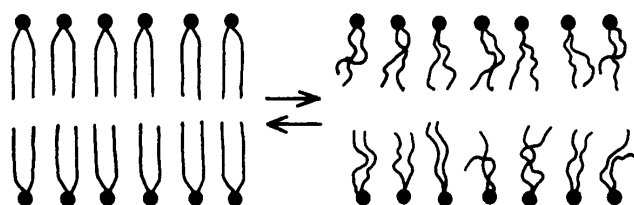


Figure 1 Phase transition of phospholipid
● : filled circles represent heads of lipids including choline group.
— : lines represent fatty acid chains.

The heat of phase transition is calculated from the area under the peak. Figure 4 shows the variation in the heat of phase transition with changing sample concentration. The value 10.4mcal/mg (7.63Kcal/mol) of the heat of phase transition obtained from this graph agrees well with the literature values^{1,2)}.

This type of phase transition in lipids is known to vary with the addition of substances such as cholesterol³⁾. Therefore, the measurement of the heat of phase transition by a scanning calorimeter is an effective method to study quantitatively the characteristics of lipids and biomembranes.

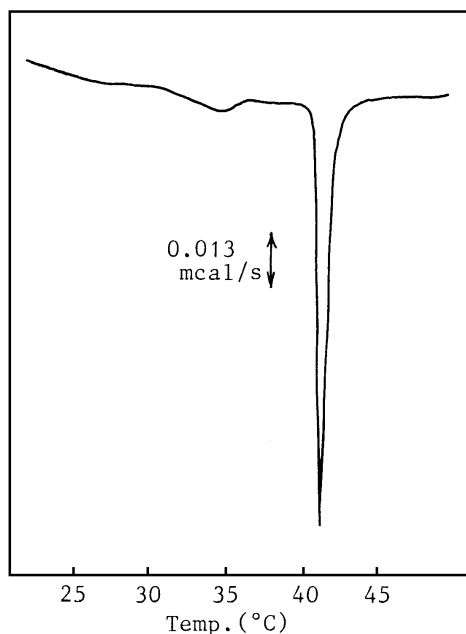


Figure 2 DSC curve of DPL (14.68mg/ml)

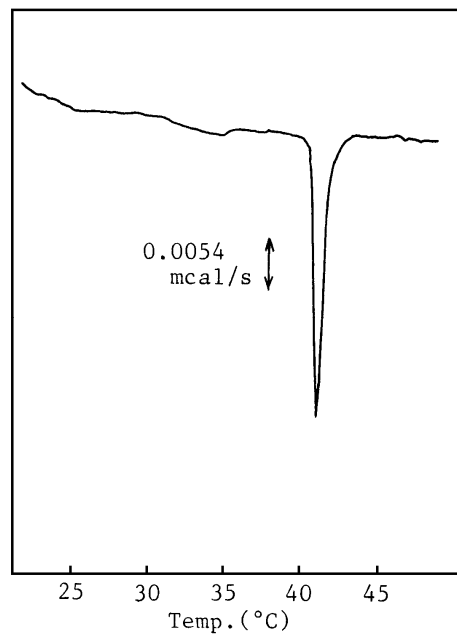


Figure 3 DSC curve of DPL (3.67mg/ml)

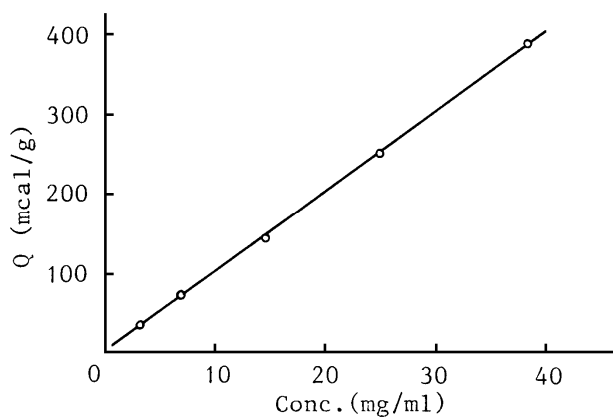


Figure 4 Heat of phase transition for DPL (ribosome)
 $\Delta H = 10.36\text{mcal/mg}$ (7.61kcal/mol)

References

- 1) H. J. Hinz and J. M. Sturtevant, *J. Biol. Chem.*, **247**, 3697 (1972)
- 2) P. D. Ross and R. N. Goldberg, *Thermochim. Acta.*, **10**, 143 (1974)
- 3) B. D. Ladbrooke and D. Chapman, *Chem. Phys. Lipids*, **3**, 327 (1969)