Structural study on the effects of poly-unsaturated and mono-unsaturated diacylglycerols on phosphatidylcholine bilayer membranes

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**Introduction**

In cell signaling processes, 1,2-diacylglycerol (DAG) is one of the most important lipid second messenger, as acting the activator of protein kinase C (PKC). In cell membranes, DAG is produced from the hydrolysis reaction of glycerophospholipid. Recent biochemical study [1] has revealed that the efficiency of activation of PKC by DAG depends on the kinds of source glycerophospholipids. That is to say, the DAG produced from phosphatidylinositol 4,5-bisphosphate (PIP2) has a higher ability to activate PKC than the DAG produced from phosphatidylcholine (PC). In eukaryotes, the acyl chains of PIP2 are mainly poly-unsaturated and on the other hand, the acyl chains of PC are mainly composed of mono-unsaturated and saturated ones. In this connection, model system studies have shown that poly-unsaturated DAGs activate more efficiently PKC than mono-unsaturated DAGs [2,3]. It has been discussed that the higher ability of poly-unsaturated DAGs to activate PKC may reflect the physical effects of their poly-unsaturated acyl chains on bilayer structure [4].

In order to clarify the difference between the effects of poly-unsaturated DAG and mono-unsaturated DAG on the bilayer structure, we compared the structural effects of 1-strearyl-2-arachidonoyl-glycerol (SAG) and 1-palmitoyl-2-oleoyl-glycerol (POG) on the 1-palmitoyl-2-oleoyl-phosphatidylcholine (POPC) bilayers by means of small angle X-ray diffraction. SAG and POG have four and one double bonds in their acyl chains, respectively. POPC is the first major component of the plasma membrane in animal cells.

**Materials and Methods**

All diacylglycerols and phospholipids used in this study were obtained from Avanti Polar Lipids, Inc (Alabaster, AL, USA) and used without further purification. The molar ratio of PC : DAG was 7:3. X-ray diffraction measurements were performed at the beamline 15A of the Photon Factory. The temperature of the samples was controlled using a modified calorimeter (FP84, Mettler, Hightstown, NJ).

**Results and Discussion**

Figure 1 shows small angle X-ray diffraction patterns of POPC-POG and POPC-SAG systems recorded during temperature scan at the rate of 2.0 °C/min. For both systems, the formation of cubic phases is observed above about 60 °C. Main difference is that the formation of inverted hexagonal phase is observed only for the POPC-POG system. Even at 40 °C, the diffraction peaks originated from inverted hexagonal phase appears for the POPC-POG system. Further detailed analysis is now in progress to determine the structural difference of the cubic phases for both systems.

Fig.1 Three-dimensional representations of X-ray diffraction patterns of (a) POPC-POG and (b) POPC-SAG systems recorded during heating scan.

**References**


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