

# Interaction between ECg and phospholipid membranes as revealed by $^{31}\text{P}$ - $^{13}\text{C}$ rotational echo double resonance (REDOR) method

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Epicatechin gallate (ECg) is one of tea catechins found in green tea, and has various physiological effects such as antioxidant and antibacterial activities. We have reported that ECg strongly interacts with the surface of phospholipid bilayers of bicelles by NOESY experiments in the solution state. However, the measurement of accurate distance between ECg and the phospholipids of lipid membranes has not been accomplished. In this study, we investigated not only intermolecular- but also intramolecular-interatomic distances between [ $^{13}\text{C}$ ]-labeled ECg ([ $^{13}\text{C}$ ]-ECg) and the phospholipid of DMPC liposomes by solid-state NMR spectroscopy.

Interatomic distance between the carbonyl carbon of ECg and the phosphorus of phospholipid was measured by means of  $^{31}\text{P}$ - $^{13}\text{C}$  rotational echo double resonance (REDOR) method for the lyophilized powder sample of DMPC liposomes with [ $^{13}\text{C}$ ]-ECg. After the measurement, we have observed REDOR and full echo spectra. The signal intensity of the carbonyl carbon of [ $^{13}\text{C}$ ]-ECg was diminished in the presence of REDOR pulse compared to the full echo spectrum. This result indicates that the carbonyl carbon is close to the phosphorus of the phospholipid. The REDOR experimental data were fitted to theoretical curves, and the interatomic distance was determined to be  $5.8 \pm 0.2 \text{ \AA}$  (Fig. 1). This value supports the results obtained by the NOESY experiment in solution NMR study. We have also succeeded to determine the intramolecular-interatomic distance between the phosphorus and the carbon of trimethyl group in the phospholipid: The accurate interatomic distance was  $5.1 \pm 0.2 \text{ \AA}$ . These values will be useful information for elucidating the interaction between tea catechins and lipid membranes.

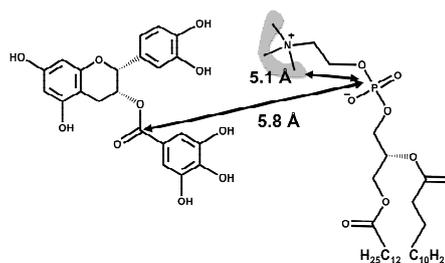


Fig. 1. The schematic representation of interaction between ECg and phospholipids obtained by the REDOR experiment.