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Education

Ph. D. (December, 1986), M. S. (March, 1983), B.A. (March, 1981): Tohoku University

Academic Carrier

1983-1985 Research Staff, Suntory Institute for Bioorganic Research.
1985-1993 Research Associate, Faculty of Agriculture, Tohoku University.
(1986 Ph. D. from Tohoku University)
(1989-1991 Post Doctoral Research Fellow at NIDDK, NIH)
1993-1999 Associate Professor, Department of Chemistry, The University of Tokyo.
1999- Professor, Department of Chemistry, Osaka University.
2010- Research Director, JST ERATO Lipid Active Structure Project

Awards and Honors

The CSJ Award for Creative Work from the Chemical Society of Japan (2007);
JSBBA Award for the Encouragement of Young Scientist from Japan Society for Bioscience and Biotechnology and Agrochemistry (1991)

Total Publications

(SCI: 139), Citation (SCI): 6,019 (2011, July), h-index: 42

Research Interests

Our group is now looking at small exogenous molecules such as natural products that possess unique biological activities by means of NMR spectroscopy and synthetic organic chemistry. We are also interested in endogenous small molecules such as lipids, sterols and peptides that form self-assemblies in membrane.

Lipid-induced Molecular Interactions in Membrane: A Molecular Structural Perspective

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Since the lipid rafts hypothesis was proposed, the formation and detection of lipid rafts in biomembranes have attracted much attention of many researchers due to their significant roles in signal transduction, cholesterol (Chol) shuttling, and protein sorting. Lipid rafts are considered to exist in a liquid-ordered phase characterized by tight ordering but relatively high lateral mobility of lipids such as sphingomyelin (SM). Instead, unsaturated phospholipids are loosely packed, forming a liquid-disordered membrane; [1] therefore the presence of Chol is generally reckoned to be a necessary requirement for the ordered phase formation. SM is known to be substantially involved in cellular events such as formation of lipid rafts. In spite of its biological significance, conformation of SM and Chol in membrane environment remains unclear because the noncrystalline property and anisotropic environment of lipid bilayers hampered the application of X-ray crystallography and NMR measurements.

To scrutinize the ordering of the SM acyl chain in the presence and absence of Chol, we prepared SMs bearing site-specifically deuterated stearoyl chains, and measured ^{2}H NMR. The results showed that the order maximized at C10 of the stearoyl chain in the presence of Chol, while it gradually decreases on going toward the terminal methyl group in the absence of Chol. These results clearly demonstrate that Chol exerts its ordering effect most effectively in the middle part of SM acyl chain owing to the rigid steroid skelton of Chol, thus suggesting that Chol distributes more deeply in SM bilayers than in DMPC membrane. This seems consistent to the umbrella effect of SM membranes. [2]

Next, to elucidate the conformation of SM in membranes, we utilized bicelles as a substitution of lipid bilayer membrane. First, we demonstrated through ^{31}P NMR, ^{2}H NMR and dynamic light scattering experiments that SM forms both oriented and isotropic bicelles by changing the ratio of SM/dihexanoyl phosphatidylcholine. Then we determined the conformation of SM in the isotropic bicelles on the basis of coupling constants and NOE correlations in ^{1}H NMR, and found that that the C2-C6 and amide group of SM take a relatively rigid conformation in bicelles.[3]

(1) Ahmed, S. N.; Brown, D. A.; London, E. *Biochemistry* **1997***, 36*, 10944–10953.
(2) Yamaguchi, T.; Suzuki, T.; Yasuda, T.; Matsumori, N.; Oishi, T.; Murata, M. **2010,** *Chem. Eur. J.*
(3) Matsumori, N.; Yasuda, T.; Okazaki, H.; Yamaguchi, T.; Oishi, T.; Murata, M. *unpublished data*.